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Ignoring the Electric Vehicle

That the healthy co-operation between central stations and electric vehicle manufacturers during the past few years is bearing fruit in the accelerated use of not only the electric truck but also the electric pleasure vehicle was fully shown at the convention in Boston on May 20 and 21, as reported elsewhere in this issue. It is not too much to claim that a large part of the activity now found in the electric vehicle industry is attributable to the influence exerted by wide-awake central stations in making known to prospective vehicle users the convenience and reliability of the electric car, both by using this type of vehicle in their own service and in giving low rates for vehicle-battery charging. It is indeed unfortunate that this highly important branch of central-station activity is to be ignored at the forthcoming convention of the National Electric Light Association, the program of which contains no paper dealing with the electric vehicle, the storage battery or the attitude of central stations toward the vehicle-battery charging load, admitted to be of the most highly desirable character.

Decreased Manufacturing Profits

The annual reports of the two great electrical manufacturing companies show that in so far as the sale of electrical apparatus is concerned the business secured during 1912 was larger than that of any other year in the history of either company. Nevertheless, the profits from the sales show a diminishing percentage, which the General Electric Company attributes to increased competition; but in what particular branch the company does not state. Suffice it to say that although the sales billed by this company in 1912 aggregated $89,182,185, the profit from the sales was less than 10 per cent, or $8,107,993; whereas in 1910, when the sales billed were a trifle over $71,000,000, the profit was $8,343,956, showing that although the sales increased more than $18,000,000 in two years, the profits decreased approximately 2.5 per cent. In the case of the Westinghouse company, the sales billed last year were $39,977,565, as compared with $38,119,312 two years previously, and the profits were $4,571,272 and $5,608,765 respectively—an increase in sales of $1,858,253 and a decrease in profits of approximately 3.5 per cent. Both of these companies do such a large proportion of the entire electrical business of the country that what is true of them is necessarily true of the industry as a whole. New developments requiring large machinery in which the percentage of profit might be larger than ordinary have not been many during the past few years, so that the business of both companies has been confined chiefly to the manufacture of smaller and standard machines, apparatus and general supplies. There is, of course, competition in these lines, but we are of the opinion that the decrease in profits may be traced to increased cost of production due to higher cost of labor and supplies rather than to competitive conditions. Moreover, it is more than likely that in future the percentage of profit will not show any increase—but, as in many other industries, the manufacturers of electrical apparatus will have to content themselves with increased sales on smaller margins of profit.

Preservation of Silvered Mirrors

In every photometric laboratory use is made of mirrors, ordinarily of silvered glass, and the care of such mirrors requires regular attention in the routine of daily use. In his article on page 1084 Dr. Louis Bell discusses the preservation of mirrors very thoroughly. A curious fact not generally known is brought out; namely, that the reflecting power of the silvering on the back of the glass is subject to some slight depreciation with time. It is a very commonly known and much resented characteristic of silvering exposed to air on the top of a glass surface to become tarnished with time, but that after the ordinary mirror has been carefully cleaned on its glass surface there should be depreciation in the coated silver surface beneath seems an unreasonable hardship. It would be interesting to know whether this is due to an oxidation caused by occluded oxygen or whether the effect is physical rather than chemical. The varnishing of specula, for the better preservation of their reflective coefficient, seems to be a simple and effective process.

"White-Way" Lighting

If one stops to consider the philosophy of the so-called "white-way" lighting a rather interesting situation discloses itself. Such lighting has been in the main installed through the initiative of the merchants in the principal business streets of the city concerned, for the purpose of obtaining such illumination as will improve their business. This simply means that streets thus lighted by private enterprise are not properly lighted by the municipality. If it is necessary to supplement the public lighting on an important street, so as to bring the illumination up to the point of maximum efficacy for the service desired, then it is self-evident that so far as municipal effort is concerned the city has not done its duty by the citizens in that particular region. Looking back a little further, one comes again upon the point which we have often mentioned in these columns, that the faults of American street-lighting practice are largely those attributable to a sort of obsession of uniformity on the part of the municipal authorities. There is a tacit assumption that every street is as good as every other street, and all the lamps which the city believes itself

able to afford are distributed with a wholly indiscriminate and moderately impartial hand over the entire territory to be lighted. The idea of uniformity, too, has often in the past, and frequently in the present, led to the adoption of a single type of lamp, generally the arc, all over the territory to be lighted. This necessitates spacing altogether too great for the illuminants used, with the result of producing dark holes all over the city, to be relieved only by private enterprise when suitable lighting becomes necessary in certain sections.

"White-way" lighting is admittedly expensive and is sometimes carried to an extent which would not ordinarily be justified in lighting at public expense. Notwithstanding this, it is certainly true that in many places the merchants have felt themselves driven to private lighting under circumstances that plainly demand an increase of public effort as well. Municipal authorities certainly owe it to their mercantile interests to provide proper illumination on business streets. Aside from general considerations, the merchants on such streets are important taxpayers, and on their activity the prosperity of the municipality as a whole largely depends. Fear of unwonted expense is undoubtedly the chief reason for hesitancy in public lighting on a brilliant scale, yet a few simple considerations, if followed out, would lead to a great betterment of present conditions and would provide good lighting without greater expense than a city owes its important streets.

In the first place, it is neither necessary nor desirable to use the same kind of lamps all over a city; both the spacing and the kind of illuminant should be adjusted to the requirements of the streets to be lighted. Secondly, it is unnecessary and sometimes undesirable to operate all the lamps all the time. Many business streets of great importance from the traffic standpoint in the early evening are practically deserted a few hours later and require only adequate lighting for police purposes. This condition is met in the ordinary "white-way" lighting by the extinguishment of the bright lights late in the evening, leaving only the municipal system in operation. There is not the slightest reason why, if economy is necessary, the public lighting suited to a busy street should not be reduced by using, say, only one-half of the lamps after midnight, when business is over and pedestrians few.

In many of the Continental cities the half-light half-night illumination scheme is now in use with highly satisfactory results. Indeed, frequently arc and incandescent lamps are installed on the same pole, the former for use during the period of bright illumination, the latter for the ordinary illumination of the deserted street. Efforts to economize in this country have usually been in the direction of the so-called moonlight schedule, which is neither one thing nor another, and is frequently inadequate. It would seem that the ultimate solution of the problem of good lighting would be to throw upon the municipality the whole burden of suitable lighting of the streets for the purposes of their use, and that even now under ordinary circumstances the city and merchants should join hands for proper illumination, instead of leaving the whole burden, as is too often the case at present, on enterprising merchants or civic organizations.

The Theoretical Basis of the Multiple-Rate System

The basis of rates for supplying electrical energy to consumers in electric service systems is of great practical importance to the corporation producing the energy, to the consumers utilizing it and to the whole community in which the service is rendered. If the rate is unfair in the direction of insufficiency the corporation is the first to suffer, but ultimately all parties suffer, because the community which has saved the capital invested in the plant cannot receive adequate compensation for this service. The plant languishes and renders inadequate service. The ill effects are shared by the public at large. If the rate is unfair in the direction of excess the consumers are the first to suffer, but ultimately all parties suffer by reason of non-expansion and discontent. Only when the rates are fair to all parties can all parties share in the benefits of the industry. A rate may be admitted to be substantially fair and yet be open to other objections. It may be unnecessarily complicated, it may be crude and unscientific, or it may be open to ambiguity and dispute. An ideal rate would be fair to all parties, easy to understand and to reckon, rationally and logically constructed, and reasonably free from misunderstanding.

In the earliest days of electric public service many contracts were made on a monthly rate per lamp installed, and no meters were used. This method of establishing rates has generally met with disfavor. It encourages extravagance and tends to tax the more thrifty consumers for the carelessness of the less thrifty. The next step was to introduce the electric meter and to make a constant rate of so much per kilowatt-hour consumed. This was a simple arrangement, but it was unfair to large users as well as to off-peak users. The next step was a multiple rate effected by a discount, or series of increasing discounts, on extended consumption. Another step in the direction of equity was the constant charge, or the minimum monthly bill. Yet another step was the introduction of the maximum-demand meter in addition to the total-energy meter.

It is well recognized that a rate should depend both on the energy consumption and on the maximum demand, since energy produced and sold during peak hours costs the producer much more than energy sold during off-peak hours. Opinions differ, however, as to the best method of establishing a rate with respect both to energy and maximum demand. Various ways have been suggested or tried for combining these two measurable quantities into the rate for direct-current service. In alternating-current service a further complexity is introduced by the consumption of reactive power.

In the case of direct-current service Mr. Hugo E. Eisenmenger has shown that the monthly bill of a consumer may always be referred to a point on the surface of a three-dimensional model, consisting of a truncated rectangular prism, resting on a horizontal rectangular base, the generating lines of which may be taken as the Y and Z axes. Distances along the Y axis correspond to maximum demand. Distances along the Z axis correspond to the monthly consumption of energy, and heights above the basis, or along the X co-ordinate, correspond to the monthly bill. The shape of the broken or truncated upper surface of the prism

shows at a glance, in a comprehensive manner, how the monthly bill depends on the rate established. In general, the broken surface will not be smooth but will contain a number of sharp ridges and furrows, which mark the points at which a discontinuity or discount occurs in the rate. It is by means of a comparison of such models, properly prepared to represent different rates, that the relative effects of such rates can be most easily apprehended. Mr. Eisenmenger's article in this number is a plea for solid rates and an interesting interpretation of rate bills expressed in terms of solid geometry. Propositions which are by no means self-evident when discussing the mere arithmetic of rates become salient when translated into solid geometry. In the absence of three dimensional models, perhaps the next best presentation of bill amounts in terms of Y and Z would be in two dimensions, on a chart of squared paper, ruled to Y and Z, with contour lines in X marked thereon in another color. Some of the advantages of Mr. Eisenmenger's models would, however, be missing in such charts.

Progress of High-Tension Cables

A paper by Dr. Lichtenstein, briefly referred to in the *Digest* this week, gives an account of recent advances in the manufacture of high-tension cables abroad, and in particular presents some details of recent work in producing and testing cables for extremely high tension. In this country practice in this direction is limited not by the skill of the manufacturer but by the demand, since we consistently shun the use of high-tension cables whenever it can be avoided. Dr. Lichtenstein declines to play the rôle of a prophet in saying what may be done in the manufacture of cables for extremely high pressures. He does, however, after noting the fact that three-phase cables up to 30,000 volts and single-phase cables up to 60,000 volts are regularly in successful use, unhesitatingly venture the opinion that the three-phase construction can be comfortably carried up to at least 40,000 volts and the single-phase construction up to 80,000 without difficulty, although such cables are not now manufactured, and inferentially leaves a very strong impression that much higher pressures even than these are entirely within the range of probability.

The *Elektrotechnische Zeitschrift* and *La Revue Electrique* have both published recent articles on some successful trials of very high-tension underground cable in Germany, at Dessau-Bitterfeld. The cables referred to are each 4.3 km long and are operated at an effective single-phase pressure of 60 kv between wires, or 30 kv between the conductor and grounded sheath of each cable. The frequency is low, being only 17 cycles per second. It is stated that these cables have been in steady operation since April, 1911. They are of the lead-covered Siemens-Schuckert subterranean type, in side-by-side conduits, 0.8 m below the ground surface. The insulator is impregnated paper, ungraded, and 13 mm in radial wall thickness. The nominal gradient of potential in the dielectric is thus $30/13 = 2.3$ kv per mm; but the curvature of the wall makes the actual maximum gradient 4.2 kv per mm at the surface of the conductor. Of course, a frequency so low as 17 cycles per second is very helpful in reducing the charging current and reactive power absorbed by the cable. On the other hand, it is very low for incandescent lighting and for the best output of transformers. It becomes increasingly evident that, whatever success can be and has been obtained with very high voltages in aerial lines in sparsely settled districts, buried cables are necessary in suburban and thickly settled districts. Energy transmission is then limited in range by the economic voltage which the cables will withstand.

The tests made on some recent cables certainly indicate that the art of insulation has made notable advances. For example, a three-phase cable with 13-mm insulation between wire and wire, and wire and sheath, was recently tested at 220,000 volts with 50 cycles per second for eighteen minutes without a puncture. The same cable was also held for a minute at 270,000 volts and for a few seconds even at 330,000 volts without puncture. This cable being nominally for use at 30,000 volts, it would be fair to set the factor of safety at about seven, which is certainly all that anybody could reasonably ask. The ordinary engineering requirements for factor of safety in the insulation do not exceed three. A thorough test at double the working voltage gives a fairly satisfactory trial of the cable for all ordinary purposes. Of course, the vital question in prescribing a test is to try out the cable under somewhere nearly the maximum voltage to which it is likely to be subjected, including such proper allowances for resonance and surges as the conditions of use would indicate. One must therefore admit that the severity of a test should depend not only on the working voltage but the nature of the service for which the cable is to be employed.

In this connection Dr. Lichtenstein refers to the very beautiful direct-current high-voltage testing equipment, which is practically an enormously high-tension commutator synchronized with the current stepped up from its connected generator. By means of this apparatus it is possible to obtain direct current for testing up to nearly 300,000 volts. The obvious advantage of such a testing set is that it enables cables to be tested in place by a reasonably portable apparatus without having to deal with the very formidable charging-current phenomena encountered at high voltage. It also makes possible, without working the voltage anywhere near its limit, to test the insulation of cable in place at somewhere near the working pressure. It is altogether probable that tests thus conducted would furnish much more valuable information regarding the condition of the cable than the ordinary tests made with a few per cent of the service voltage. Of course, the use of any such apparatus involves the unknown relation between the endurance of a cable under alternating and under direct current. That the latter is much easier on the cable than the former is well known. The difference between the two is sometimes set as high as three to one, which is probably in excess of the truth. There is a liability, we think, in the use of very high unidirectional voltage to produce gradual quasi-electrolytic effects on the insulation which have not yet been sufficiently taken account of in the comparison. At all events, Dr. Lichtenstein's paper makes it perfectly clear that cable manufacture is now well in advance of the present requirements of American practice.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

N. E. L. A. Convention Preparations

Advance registrations for the annual convention of the National Electric Light Association to be held in Medinah Temple, Cass and Ohio Streets, Chicago, June 2-6, are coming in rapidly and a very large attendance is assured. Present indications are that the number attending the convention will be about 6000.

Nearly all the space in the basement of the Temple has been sold to Class D members for exhibits of electrical apparatus. Original and beautiful illuminating effects are planned for the exhibit hall. The Commercial Section will hold its meetings in a large tent in the rear of the Temple, and this will be handsomely decorated and effectively illuminated. The tent will cover a ground area of 50 ft. by 80 ft. and will provide sittings for about 700 persons.

Subject to change, the general program of entertainments has been planned by the local convention committee, of which Mr. Samuel Insull is chairman. The opening of the exhibition will take place at 8 p.m. on Monday, June 2. There will be a reception in the main auditorium of Medinah Temple followed by dancing. On Tuesday afternoon, beginning at 3 p.m., there will be a musicale in the ballroom of the Blackstone Hall, at Michigan Avenue and Hubbard Place. Grand-opera artists will provide the singing and instrumental music on this occasion. This feature is for visiting ladies only. A vaudeville entertainment will be provided for all convention visitors on Tuesday evening in the main auditorium of Medinah Temple.

For Wednesday afternoon a number of industrial excursions are planned. One will be to the Hawthorne works of the Western Electric Company and another to the Northwest generating station of the Commonwealth Edison Company. At the latter place there are extensive recreation grounds, and one of the features of the convention will be a baseball game between the "East" and the "West" on these grounds on Wednesday afternoon. For the ladies' entertainment on Wednesday afternoon there will be a matinee party at the Auditorium Theater to witness the pageant entitled "Darkness and Light." In connection with this the ladies will be given an opportunity to witness the spectacle and exposition in the Coliseum known as "The World in Chicago."

Other optional industrial excursions are planned for Wednesday afternoon. One is a visit to the Chicago Drainage Canal, with its hydroelectric development, at the invitation of the Sanitary District of Chicago. Another is a trip to Gary, Ind., to inspect the great steel works of the Indiana Steel Company with their interesting gas-engine and electrical equipment. A third available trip is to the Union Stock Yards, and still another is to "Underground Chicago," the unique network of tunnels underlying the central portion of Chicago and provided with electrically operated freight tramways.

For visiting ladies only there is provided on Thursday what should prove to be a very enjoyable outing. Leaving the Art Institute at Michigan Avenue and East Adams Street at 10:30 a.m., the ladies will be taken for a 50-mile automobile trip. The party will proceed through Lincoln Park, Sheridan Road and the beautiful North Shore suburbs to Highland Park. Here, at the Moraine Hotel, a luncheon will be served. The return will be made in the same manner in the afternoon, the ladies being taken by automobiles to their respective hotels, which will be reached about 5:30 p.m.

On Thursday evening will take place the great Jovian rejuvenation in the ballroom at White City, a large amusement park at East Sixty-third Street and South Park Avenue. A joviation will follow the rejuvenation, and it is expected that about 1500 Jovians will be present.

Pittsburgh Convention I. E. S.

At a meeting of the convention committee of the Illuminating Engineering Society held in Pittsburgh on May 16 it was decided to hold the next annual convention of the society in that city during the week beginning Sept. 22. In addition to the regular technical sessions there will be a reception and dance and several excursions to points of interest in Pittsburgh. Prof. H. S. Hower, of the Carnegie Technical Schools, is chairman of the Pittsburgh Section, I. E. S. The chairman of the local committee on arrangements is Mr. W. A. Donkin, of the Duquesne Light Company; Mr. J. C. McQuiston, of the Westinghouse Electric & Manufacturing Company, is chairman of the publicity committee. The president of the society is Mr. P. S. Millar, Electrical Testing Laboratories, New York, and the secretary is Mr. Joseph D. Israel, of the Philadelphia Electric Company.

National Committee on Electrolysis

The joint national committee on electrolysis will meet for the first time at the headquarters of the American Institute of Electrical Engineers in the Engineering Societies Building, New York, on Tuesday, May 27, at 3 p.m. The committee will consider the subject of electrolysis broadly and if possible agree upon some basic principles or method of procedure to be followed in the case of electrolytic dispute. The American Electric Railway Association, the American Railway Engineering Association, the National Electric Light Association, the American Telephone & Telegraph Company and the American Institute of Electrical Engineers have each appointed three representatives, and it is expected that the representatives of the American Water Works Association, the Natural Gas Association of America and the American Gas Institute will be announced shortly. It is the purpose to organize the committee at the first meeting and to outline some definite plan of action. The delegates appointed by each of the national bodies invited to participate in the conference are as follows: American Electric Railway Association—Mr. R. P. Stevens, Lehigh Valley Transit Company, Allentown, Pa.; Prof. A. S. Richey, Worcester Polytechnic Institute, Worcester, Mass.; Mr. Calvert Townley, Westinghouse Electric & Manufacturing Company, New York. American Railway Engineering Association—Mr. E. B. Katté, New York Central & Hudson River Railroad Company, New York; Mr. D. J. Brumley, Illinois Central Railroad Company, Chicago, Ill.; Mr. W. I. Trench, Baltimore & Ohio Railroad Company, Baltimore, Md. National Electric Light Association—Mr. Philip Torchio, New York Edison Company; Mr. L. L. Elden, Edison Electric Illuminating Company of

Boston; Mr. D. W. Roper, Commonwealth Edison Company, Chicago, Ill. American Telephone & Telegraph Company—Mr. H. S. Warren, American Telephone & Telegraph Company, New York; Mr. F. L. Rhodes, American Telephone & Telegraph Company, New York. American Institute of Electrical Engineers—Mr. B. J. Arnold, Chicago, Ill.; Mr. F. N. Waterman, New York; Mr. Paul Winsor, Boston, Mass.

International Engineering Congress

A committee on management of the International Engineering Congress, which will be held in connection with the Panama-Pacific International Exposition at San Francisco in 1915, has been appointed, consisting of the presidents and secretaries of the five national engineering societies under the auspices of which the congress is to be conducted, together with eighteen members resident in San Francisco. The committee has selected as its chairman Prof. W. F. Durand, of the American Society of Mechanical Engineers, and as its secretary-treasurer Mr. W. A. Cattell, of the American Society of Civil Engineers. The executive offices will be in the Foxcroft Building, 68 Post Street, San Francisco.

Chairman Durand has selected members for the papers, finance, publicity and local affairs committees as follows: Papers committee, Mr. A. M. Hunt, American Institute of Electrical Engineers, chairman; finance committee, Mr. W. G. Dodd, Society of Naval Architects and Marine Engineers, chairman; publicity committee, Mr. W. A. Cattell, chairman, and local affairs committee, Mr. E. A. Benjamin, American Institute of Mining Engineers, chairman.

Fall Convention of New England N. E. L. A. Section

The program is now being made up for the fall convention of the New England N. E. L. A. Section at Burlington, Vt., on Sept. 17, 18 and 19, and the following titles have been selected for the papers to be presented: "Co-operation of Allied Electrical Industries," "Problems of Central-Station Managers in Cities of Less Than 5000 Inhabitants," "How Present Models of Electric Heating and Cooking Appliances Might Be Improved to Increase the Use of Electricity in the Home," "Principles Governing Central Stations in Line Extensions and Various Rulings of Commissions Thereon," and "The Central Station's Attitude Toward Its Customers." Mr. C. C. Wells, Middlebury, Vt., has been appointed chairman of the hotel and entertainment committee, and Mr. E. S. Mansfield, Boston, Mass., is chairman of the publicity and transportation committee. The secretary of the New England Section is Miss O. A. Bursiel, 149 Tremont Street, Boston, Mass.

N. E. L. A. Rate Research

The rate research committee of the National Electric Light Association has printed its first volume, containing 420 pages, with index. The index is probably the best bibliography of rate regulation information that is published and should be very beneficial in preparing briefs and other memoranda upon regulation matters. One interesting feature of this publication is the fact that it is not published for profit, although it is self-supporting. It supplements the work of technical journals by calling attention to all of the important articles which such papers publish on the subject of rate regulation. It is pleasant to record that this publication has been given a warm welcome. Mr. E. W. Lloyd is chairman of the rate research committee and Mr. W. J. Norton, 120 West Adams Street, Chicago, is secretary of the committee and editor of *Rate Research*.

Change in Electrical Development Society Program

The annual meeting of the Society for Electrical Development, Inc., will be held at 11 a. m. June 2, at the Hotel Sherman, Chicago, instead of on May 31, as at first announced by the society.

New Officers of A. I. E. E.

The annual business meeting of the American Institute of Electrical Engineers was held on May 20 in the Engineering Societies Building, New York. The report of the board of directors for the fiscal year ended April 30 was rendered and announcement was made of the results of the election of officers for the year 1913-1914, as follows: President, Mr. C. O. Mailloux; vice-presidents, Messrs. H. H. Barnes, J. A. Lighthipe and C. E. Scribner; managers, Messrs. B. A. Behrend, P. Junkersfeld, H. A. Lardner and L. T. Robinson; treasurer, Mr. G. H. Hamilton.

Electrification of Railroads

At the meeting of the American Institute of Electrical Engineers held in New York on May 20 two papers were presented on railroad electrification. The first paper, by Mr. H. M. Hobart, consulting engineer of the General Electric Company, dealt with the proposition of steam-road electrification using direct current at 2400 volts. Mr. C. P. Kahler, electrical engineer for the Oregon Short Line Railroad, followed with a paper treating the same proposition from the standpoint of alternating-current operation.

2400-Volt Railway Electrification

Mr. Hobart's paper was a dissertation on the advantages of the direct-current electric locomotive versus steam locomotive railway operation. It is pretty generally conceded that for dense-traffic sections electric operation is the more economical, but this paper went a step further, taking the discussion into the field of long-haul passenger express and freight service. That there is room for comparison of the electric and steam locomotive in this field was ascribed by the author to developments in the central-station industry in recent years. It was asserted that under present conditions a railroad can in many cases better afford to purchase its supply of energy for electric operation from adjacent central stations than to tie up sufficient capital to maintain its own stations. Moreover, Mr. Hobart thought that, since this load will tend to improve the central-station load-factor, the energy can be profitably supplied from that source at a lower figure than the cost of generating it in stations operated by the railroad. He said that 0.7 cent per kw-hr. is a fair estimate of what electric energy will cost at present for this purpose, the power-factor being unity. For lagging current the rate would be higher and for leading current lower, he thought. The comparative estimates given in the paper were made on the supposition that central-station energy would be used. In the first case considered—that of a long-haul, non-stop passenger express service—the author advocated 2400-volt direct-current operation.

Such a system, the author asserted, would allow of economical spacing of substations at intervals of about 30 miles. Single motors would be replaced by pairs of 1200-volt motors in series, two or more pairs being operated in parallel according to the number of driving axles. On long-haul service the author stated that there is less justification for the series-parallel control then on a frequent-stop service. The economy of electric-locomotive haulage on mountain-grade sections with 2400-volt direct current was then urged, extensive estimates of the operating and equipment costs being given for several cases. It was pointed out that

a poorer grade of coal can be economically used by the central station than by the steam locomotive and that this circumstance favors electric operation.

Trunk-Line Electrification

Mr. Kahler introduced his paper with the statement that it had as far as possible been arranged so as to be intelligible to railway men, as it was to that class he wished particularly to appeal. The extremely large initial investment necessary for the electrification of steam roads has been one of the obstacles in the path of a general movement in that direction. Most of the work that has been done along that line so far has been due to the fact that on the sections in question there are conditions to be met that absolutely preclude steam operation. Nevertheless, observation and comparison of these electrically operated sections with known characteristics of steam operation have revealed many advantages for the former system. Mr. Kahler's paper was a detailed investigation of these factors. The effects of physical (or topographical) characteristics and class of locomotive on the operating expenses were first discussed, and following that the process by which certain classes of passenger and freight traffic have already been largely taken from the steam roads by electric lines. A proposed railway system was then laid out, traffic conditions and physical characteristics were indicated, and a comparison was made of estimates as to the relative equipment and operating costs of electric and steam locomotive haulage. Single-phase operation was assumed, energy being supplied from parallel 60-cycle and 15-cycle transmission lines with frequency changers interposed. The comparison was made on the basis of the standard account items required by the Interstate Commerce Commission and was supplemented by numerous tables of operating costs. Assuming that energy was purchased from a central station at an attractive rate, the summation and comparison of these estimated costs showed that, while the initial expense of electrifying the hypothetical system would be large, the annual saving over steam operation accomplished thereby would be from 9 to 11 per cent of the necessary investment. Another conclusion reached was that by reason of the better overload characteristics of the electric locomotives they can be operated to advantage over heavier and longer grades than can steam locomotives, so that the expense of grade reduction can be eliminated. Finally, Mr. Kahler thought that by proper co-operation between railroads and central stations in the building of transmission lines along railway rights-of-way mutual advantages would accrue, because it would allow of the development of hydroelectric sites that would not be otherwise commercially possible and would at the same time afford a ready source of supply when the time comes that electrification is necessary.

Discussion

In opening the discussion Mr. Sprague said that it was a significant fact that two investigators, working independently and advocating different systems of operation, should arrive at practically the same conclusions as to the economy of electrification of steam roads and under conditions hitherto held to prohibit economical electric operation. He thought it also worthy of note that both papers advocated the purchase, rather than the generation, of electrical energy. The system advocated and assumptions made in Mr. Hobart's paper he considered the safer and more practical, and in his opinion the operation of parallel 60-cycle and 15-cycle transmission lines, with frequency changers interposed, was impracticable and would introduce sufficient extra running equipment to rob the single-phase operation of one of its principal claims, that of simplicity. He closed by saying that the optimism shown in the two papers was justified by his own observation and experience.

Mr. A. H. Armstrong, of the General Electric Company, expressed the opinion that in planning the electrification of steam roads the requirements of the future should receive careful consideration and the system installed should be able to expand to meet the future demands. He admitted that on traffic of low density the single-phase alternating-current operation possesses some advantages, but thought that for heavy or medium traffic conditions direct-current operation is essentially better. However, he said that, whichever system is adopted, it will probably have little effect on the type of motor used, since the development of the steel-container mercury-arc rectifier has advanced to a stage where it is capable of handling heavy loads. By installing such rectifiers, either directly on the electric locomotives or in substations, he thought that at an early date the advantages of alternating-current transmission and of direct-current drive can be combined so as to make electrification still more attractive. In closing he said that the General Electric Company had recently made tests on a locomotive using a 1000-kw mercury-arc rectifier with very satisfactory results. Moreover, the 2400-volt system proposed by Mr. Hobart does not represent the practical limit of direct-current operation, because 5000 volts has been used satisfactorily.

Mr. F. E. Wynne, of the Westinghouse Electric & Manufacturing Company, championed Mr. Kahler's solution of the problem. He introduced several charts showing in graphic form the results obtained in the second paper, and he expressed the opinion that the paper's chief value lay in the fact that it pointed the correct way to attack the problem of comparing costs of electric versus steam operation. After discussing several of the tables in Mr. Kahler's paper he turned to the question of direct-current operation. Mr. Hobart's paper, he thought, was an excellent academic treatment of the subject, but in his estimation the assumptions made in it were not in line with actual practice in steam or electric railway operation. In particular, he thought, an operating voltage of 2400 much too low for handling heavy traffic effectively.

Mr. W. S. Murray expressed the opinion that future improvements in steam-locomotive operation might have a large bearing on the subject and might make electrification seem less advisable than at present. He thought that the limitations of steam operation had not yet been reached, and that oil-burning or automatic stoking might be developed in the future to keep pace with electric locomotive progress.

Boston Edison Service Annuities

Extending a carefully planned welfare program begun about a year ago, the Edison Electric Illuminating Company of Boston placed in effect on May 1 a system of service annuities which represents an advanced method of dealing with the retirement problem and insures unusually liberal compensation to employees of long standing and good records. The plan comprises several distinct improvements over any known pension system in use at present by a public-service corporation. Retirement under the provisions of the system is not compulsory; the rates of payment are exceptionally high; close articulation is provided with the existing system of disability payments in the company; no maximum limit is placed on the amount of the annuity; the payments are non-contributory from the employee's standpoint, and death benefits are protected. Another notable feature is the inclusion of service in public-service corporations acquired by the company in figuring the duration of employment upon which the pension is based.

With the establishment of the company's welfare bureau in 1912, three important provisions were put in force, classified as industrial accident benefits, sick benefits and death benefits. These provisions not only include all the provisions formulated under the Massachusetts workingmen's compensation act, but in addition provide that a man shall receive sick benefits for one-quarter of his length of service.

Another advantage over the provisions of the Massachusetts act is that the company goes farther than the so-called ten-dollar maximum. The act provides that a man shall receive one-half his weekly wage in case of disability, not to exceed $10 weekly. The company does not limit itself to this, but applies the proportional rates of payment directly to the man's full salary, regardless of what the maximum disability payment figures out. The new pension system provides for three classifications, as follows: (a) Providing for the retirement of male employees at sixty-five years of age, with fifteen years of continuous service, and for the retirement of female employees at sixty years, to be retired upon individual request or at the discretion of the committee in charge of the plan; (b) the retirement of male employees of sixty years of age with twenty years' service and of female employees of fifty-five with twenty years of service, to be retired at the discretion of the committee; (c) employees completing thirty years' continuous service, irrespective of age, also at the discretion of the committee. These terms of service include faithful service in the same kind of a company in the electrical business whose business has been acquired by the Edison company, or specifically in the electric-lighting department of any public utility operating in the public streets of the State, which has been added to the company's system.

The amount of the service annuity to be paid yearly to an employee retired under this plan is 1 per cent of the average annual pay of that employee during the last ten years of active service multiplied by the number of years of service, provided, however, that no service annuity shall be less than $300 per year. All service annuities are payable monthly and are not assignable. In case an attempt is made to assign an annuity, or if it is attached, or if the annuitant becomes bankrupt or insolvent, the right to the annuity ceases, and the annuity may be either suspended or withdrawn, or paid to the annuitant or his dependents, all at the discretion of the committee in charge. Overtime pay is excluded in determining the average annual pay. Leave of absence for special reasons or absence on account of illness does not constitute a break in the continuity of an employee's service, but if such absence exceeds three months, the excess is deducted in computing the length of service. Service annuities continue from the date of retirement to the end of the calendar month in which occurs the decease of the annuitant.

The plan is distinctive in that no employee loses the advantage of the death-benefit provision of the welfare program. If an employee is on the disability payroll at the time he becomes eligible to a service annuity, he may nevertheless be retired upon an annuity and when so retired is no longer entitled to the benefits of the disability payroll. The death benefit conditions, however, provide for the payment to the employee's heirs at the time of his or her death of twenty-six times the weekly wage, the maximum payment to be $500 and the minimum not less than $100. Without special provision, it might happen that an employee would die just at the time of passing from the regular payroll to the annuity pension class or within a short time after having been transferred, and thus his family would be deprived of the regular death benefit allowance. This cannot happen under the provisions of the Boston Edison plan, because any differences between the death benefit and the amount received in pension up to the time of death are made up by the company. An employee who has been retired with a service annuity will continue to receive it so long as he does not, in the judgment of the committee, engage in any business which is in competition with the company or act in an unfriendly manner toward it, or become undeserving through misconduct or otherwise.

At present there are over 1600 employees on the Boston Edison payroll, and at least twenty-five employees are eligible for retirement at once, if held desirable. Among the employees are men whose ages range from sixty-five to seventy-seven years and whose terms of continuous service range from eighteen years eight months to thirty-two years one month. The administration of the plan for retirement with service annuities is in charge of the following committee: President Charles L. Edgar and Messrs. Walter C. Baylies, Thomas K. Cummins, Frederick Manley Ives and Herbert W. Moses.

Terminal Electrification in Chicago

The question of the possible electrification of the trunk-line railroad terminals in Chicago is bound up with the sorely needed relocation and modernization of several of the terminals of the twenty-six railroads that enter Chicago. The whole subject is under consideration by the railway terminals committee of the City Council; and, for perhaps the first time, the railroads are showing a willingness to cooperate with the city authorities. At a meeting of the committee on May 17 Mr. Robert Redfield, a lawyer, appeared for several of the railroad companies. He introduced Mr. A. J. Earling, president of the Chicago, Milwaukee & St. Paul Railway Company, who said that five roads use the so-called Union Station on Canal Street. Plans have been prepared for a large and handsome station to supersede this, the "head house" to be in the block bounded by West Adams, South Canal, West Jackson and South Clinton Streets, fronting on Canal Street. Architect E. R. Graham, of D. H. Burnham & Company, produced drawings and described briefly the handsome and imposing structure proposed. Apparently the station is designed for electrically operated trains. Mr. Earling said that the Jarvis Hunt plans for one great railroad terminal in Chicago operating on the terminal-loop principle are entirely impracticable.

Mr. Darius Miller, president of the Chicago, Burlington & Quincy Railroad Company, another road using the Union Station, where 250 passenger trains are handled daily, also expressed the opinion that the Hunt plans are impracticable.

Mr. J. J. Turner, of Pittsburgh, second vice-president of the Pennsylvania Lines West of Pittsburgh, declared that the proposal of the Chicago Plan Commission to mass railroad terminals on Twelfth Street is impracticable. He said that the railroad traffic of Chicago is so large that one union station is impracticable. The railroads are unanimous in opposing the Hunt plans, according to Mr. Turner.

Mr. F. A. Delano, president and one of the receivers of the Wabash Railroad, disagreed with the preceding speakers. He thinks the Hunt plan a valuable contribution to the study of the subject, although no doubt a better plan can be worked out. Mr. Delano has given much attention to the Chicago terminal problem. Several years ago he recommended the grouping of terminals on Twelfth Street, although still open to conviction on the subject. Mr. Delano gave an interesting exposition of railroad-terminal conditions in Chicago, where there are six passenger stations, each caring for from one to seven roads. He mentioned the interesting fact that the New York Central terminal in New York has a greater capacity for handling trains than all the passenger terminals of Chicago put together. He showed how terminal electrification makes it possible to build fine structures, as hotels, stores and clubs, over the subsurface area used by the railroads.

Mr. A. H. Smith, of New York, vice-president and general manager of the New York Central Company, made an interesting contribution to the discussion. He said that his company is satisfied with the La Salle Street Station and is not committed to any new terminal, although a change will have to come, no doubt, within the next ten years. He would not express an opinion on the practicability of the Hunt plan. He made it clear that the New York Central would not consent to any relocation that would put it at a

disadvantage compared with the other railroads. He does not think it practicable to house the New York Central and Pennsylvania lines in one station in Chicago. The terminal electrification in New York was brought about by the tunnel conditions in that city. It is practicable but very expensive. The electrification question is up everywhere, but the railroads think the cost is very heavy. Steam locomotives are perfected to a greater degree than electric locomotives, for they have been in use much longer. The trouble with the electric locomotive is to make it capable of pulling a heavy load at high speed, although the railroads do not ask it to do anything a steam locomotive cannot do. However, improvements are being made constantly, and Mr. Smith thinks the desired electric locomotive will be available before long. But while these experiments are going on somebody must pay the expense in the shape of overhead charges. In answer to a question, the speaker said that he did not know of any practicable means of hauling heavy railroad trains save steam and electricity.

The committee adjourned to consider the subject further at its next meeting.

Electric Vehicle Convention at Boston

A special convention of central-station men, electric-vehicle and accessory manufacturers was held in the Engineers' Club auditorium, Boston, on May 20 and 21 under the auspices of the New England Section of the Electric Vehicle Association of America and the Electric Motor Club of Boston, about 100 persons being in attendance, including registrations from New York, Philadelphia and points in the Middle West. The first session began with a paper by Mr. Fred M. Kimball, of the General Electric Company, on "New England as an Electric-Vehicle Field."

The Electric Vehicle in New England

Mr. Kimball reviewed the history of electric-vehicle development in New England and emphasized the improvements in the last few years leading to the popularization of both pleasure cars and trucks. The author defined the possibilities of present designs and showed that as a general proposition a given number of commercial electric vehicles can perform fully twice the service that an equal number of horse-drawn vehicles of equal carrying capacity can perform in the same period of time, while the cost of operation will be from two-thirds to one-half that of the horse-drawn apparatus. The commercial truck occupies on the streets not over half the space of a horse-drawn truck of equal capacity, and its service reliability is independent of climatic conditions. Other well-known advantages were cited and the author pointed out the attractions of the New England highways and the highly developed roadways of the Boston district as incentives toward a greater electric-vehicle development. The registration of electric vehicles in Massachusetts in 1913 is thus far 30 per cent ahead of last year's record. The estimated present income of central stations from electric vehicles is about $900,000 per year, figured on the basis of 4 cents per kw-hr. It is estimated that about 40,000 of these machines will be in service by the end of the year. In closing, the author outlined several fields peculiarly adapted to electric-vehicle service, including the delivery of milk and ice in the early morning hours in suburban residential districts.

Discussion

Among those discussing the paper were Messrs. Harvey Robinson, New York; P. E. Whiting, Boston; F. D. Stidham, Boston; L. A. Tirrell, Boston, and Colonel E. M. W. Bailey, Boston. The point was brought out that 10 per cent is a liberal allowance for replacements in connection with electric vehicles. Rolling country was shown to be no disadvantage in maintaining battery-driven car schedules.

Criticisms on Electric Vehicles

Mr. E. R. Davenport, sales manager of the Narragansett Electric Lighting Company, Providence, R. I., presented a trenchant paper discussing with the utmost frankness some of the weak points in electric-vehicle salesmanship and service which retard the logical development of the industry. He contended that the time has arrived for a reduction in the prices charged for electric pleasure cars and urged the adoption of methods of marketing and distribution along the lines practised by the largest manufacturer of modern low-priced gasoline automobiles, who is building no less than 200,000 cars this year and securing a small unit profit on each with a correspondingly large total. Mr. Davenport said that it should be possible to retail a good electric pleasure car for $1,250, figuring battery cost at $350 to $400, motors at $115 each, and using assembled frames, axles and bodies. The tendency toward increased prices was deprecated, and the author said that in his territory people will not invest $2,250 for a runabout which could not be expected to go over 75 miles on a charge. There are many people who would like to own an electric runabout for city service, but the present high first cost is a serious obstacle. There is no question that any agent with an electric roadster selling for $1,250 could sell the car without any form of catalog and any central station could afford to buy such cars and use them for purposes for which large and expensive electric roadsters are not adapted.

Prices charged for commercial electric vehicles are high, but not as exorbitant as those for pleasure cars. A great future lies ahead of the commercial car, but the practice of showing what can be done with a demonstrating car is a vital necessity and one which remains to be appreciated in the electric-truck field as it now is in the gasoline-car industry. The author affirmed that an agent who is covering the entire New England territory should at least own a demonstrating car and be willing to do the customer's work in case he is in the market for either an electric or a gasoline truck. Many electric-truck salesmen are at a disadvantage through their previous familiarity with the gasoline machine. Salesmen should be better posted on such matters as the actual weights of their cars complete and the mileage which can be handled by both gasoline and electric delivery wagons including stops.

Regarding the question of service after purchase, Mr. Davenport made several telling points indicating the great importance of following up the customer's use of his equipment and seeing to it that he secures the best possible results. Insufficient care is at present taken to provide for inspection of individual cars at regular intervals. The manufacturer of the vehicle should be more willing to bear some share in the replacement of small parts proving defective, rather than leave this burden upon the central station, which often secures a gross income of only $60 or $70 a year from the vehicle owner, compared with an agent's profit of say $500 on the sale of a pleasure car. The customer should not be left to his own resources after the car is delivered and has had an initial charge under the direction of the sales representative. A number of actual cases were then cited where the central station was called upon to do more than its fair share of the service work, considering the moderate revenue involved. In one of these the Narragansett electric-vehicle man had to make ten calls while supervising the installation of a charging set which was sold at cost, to insist on the use of distilled water and to instruct the coachman in the handling of a battery-testing hydrometer. In another a leaky cell was removed by an incompetent man owing to the lack of any method of having the distant agent attend to the problem or advise upon it, and the central-station man had to devote an entire morning to rectifying matters. The car owner had never received the signed guarantee that should have accompanied the battery. In another instance the

vehicle representative failed to inform the customer of the value and uses of the hydrometer, syringe, distilled water and a thermometer suitable for use in such a battery when being charged. The author in closing reiterated the need of closer co-operation between the battery and vehicle makers and the central station and advocated "getting together" to adjust more equitably the costs of rendering the service upon which the largest success of the electric vehicle depends.

SELLING ELECTRIC CARS

Mr. Louis E. Burr, president of the Woods Motor Vehicle Company, Chicago, in a paper on the proper selling of electric cars, touched upon the improved conditions regarding local charging facilities now being inaugurated in many parts of the country and set forth the importance of the use of electric cars by central stations in carrying on effective selling campaigns. Low prices for energy are vital. Service guarantees should be definite, as in many cases the car owner's ideas of service guarantee and maintenance become mixed and he gets the notion that he can operate his car at no cost except the garage charges. The Electric Automobile Manufacturers' Association is now considering a standard service along the following lines: Free inspection monthly at a specified time; gratuitous examination of the wiring, motor, controller, gearing, brakes and battery; free oiling exclusive of repacking bearings or gears in grease; notification of owner when repairs are needed. This service will in no way eliminate the responsibility of the garage, but will do much to insure better operation and determine the limits of free repairs and adjustments.

Mr. Burr's paper concluded with a discussion of the need of closer co-operation between electric-vehicle salesmen and manufacturers, leading to more permanent employment and service of greater loyalty.

ADVERTISING THE ELECTRIC VEHICLE

Mr. F. Nelson Carle, advertising manager General Vehicle Company, Long Island City, N. Y., presented a paper urging that sound design, sane speeds and other fundamentals of long-lived construction are characteristic of the electric-truck industry, and that sound selling methods are a striking feature of its work. How to make the turn-over and how to expand at the same time is the problem of the manufacturer rather than what shall be next year's model. The author advocated conservative expansion and the gradual establishment of district offices and selling representatives as the growth of the business warrants. He favored the wide use of localized electric-truck advertising in good press mediums. The local advertising must be adapted to road and traffic conditions and the status of the electric truck and delivery contractor. The use of advertising copy on the news pages was recommended and the value of selective trade paper advertising emphasized. Commendation was given to the Electric Vehicle Association of America's magazine advertising, and the author said that central-station advertising in the interest of the electric vehicle is increasing yearly.

Too much importance, Mr. Carle said, cannot be attached to understanding local conditions. In a typical case a well-planned advertising campaign fell flat because the preparation of the copy did not take account of the fact that 70 per cent of the local deliveries were handled by three contractors. The advertiser had been talking to merchants about the high cost of horses when some of them had not owned a horse for five years. In this work the co-operation of the central station is of supreme importance. Electric-truck advertising has won men to see that the machines of this type are superior in their own field, and the problem now is to educate the public to see the size of the field. Impress upon the prospective buyer the importance of adaptability as a factor in operating efficiency and the value of simplicity of construction and operation as factors in the labor problem. The electric-truck advertiser is not a mud slinger but a seller of transportation machinery.

ADVANTAGES OF CO-OPERATION

Mr. E. J. W. Proffitt, of the Proffitt-Lanhar Advertising Corporation, Providence, R. I., emphasized the need of co-operation between seller, purchaser and advertising man in the securing of the best results from the electric vehicle. He commended the voluntary expenditure of $50,000 within a few months by the Electric Vehicle Association of America in a publicity campaign and voiced the improvements in vehicle construction which have made it a thoroughly practical device. He contended that as the greater population and financial resources of the East make it the logical field for maximum electric-vehicle application, appropriations for publicity should be made with the idea of concentrating advertising work in this territory, especially in newspapers of great local prestige. The electric-vehicle manufacturer has in the past failed to take as much advantage of this outlet as has the gasoline-car builder. The central stations and vehicle manufacturers should supplement the advertising of the national organization by publicity prepared under their own supervision and co-operation.

The author suggested that the vehicle manufacturer should reimburse the central station to the extent of allowing the latter a certain sum for every vehicle sold in the territory, say from $50 to $100, depending on the size of the car. The manufacturer could then advertise the service arrangement and it would prove a very valuable selling feature, making it possible for the central station aggressively to push the business to its own and the manufacturer's gain.

Discussion

The papers by Messrs. Carle and Proffitt were discussed by Messrs. William Bee, Orange, N. J.; J. E. Gray, Providence, R. I.; Colonel E. W. M. Bailey, Amesbury, Mass.; J. C. Bartlett, Philadelphia; H. W. Hillman, Long Island City, N. Y.; Henry Goodman, Buffalo, N. Y.; Harvey Robinson, New York; Day Baker, Boston; J. S. Codman, Boston; A. D. Putnam, Worcester, Mass.; C. D. Marsh, New York, and W. C. Anderson, Detroit, Mich.

The point was made that the pleasure electric vehicle must be made to appeal to the person of large means; that it is unnecessary as yet to attempt to produce a low-priced car, and that concentrated advertising is of the greatest value. The rich man is the natural purchaser of the three-thousand-dollar electric vehicle. The excellent income characteristics of the electric vehicle in relation to demand upon the station were emphasized. The success of the new car is chiefly due to the improved service which it gives and to the service of the best manufacturers and central stations. The payment of a proportion of central-station electric-vehicle advertising by manufacturers was advocated as a means of arousing many of the electric-service companies to the value of the electric-vehicle load, and other speakers favored allowing a percentage from manufacturers to meet the cost of central-station inspection service upon pleasure cars in operation in local territory.

In a later issue will appear abstracts of papers presented by Messrs. H. H. Rice, L. R. Wallis and W. C. Anderson on the popularity of the electric vehicle and the proper attitude of central stations toward electric-vehicle owners.

ENTERTAINMENT FEATURES

At the close of the meetings special cars were taken to the River Works of the General Electric Company at Lynn, Mass., and to Bass Point, Nahant, where field sports and a shore dinner were enjoyed. An informal parade of electric pleasure cars and trucks took place in front of the Engineers' Club on Tuesday afternoon.

West Virginia Public Utility Act

The act of the last legislature of West Virginia creating a public service commission goes into effect this month, and it is expected that the Governor will announce the names of the commissioners in a few days. There are to be four commissioners, whose term of service will be eight years, and the salary attached to the office is $6,000. The jurisdiction of the commission extends over common carriers, railroads, street railroads, express companies, freight lines, car companies, toll bridges and ferries; telegraph and telephone companies and pipe-line companies for the transportation of oil, gas or water; gas companies, electric-lighting companies and municipalities furnishing gas or electricity for lighting, heating or industrial purposes; hydroelectric companies for the generation and transmission of electricity, water companies, and all persons, associations, corporations and agencies employed or engaged in any of the businesses enumerated. The commission will also perform such duties as may be imposed upon it by law in connection with any workmen's compensation law or fund which may be established. It is empowered to change any intrastate rate, charge or toll which is unjust or unreasonable and may prescribe such rate, charge or toll as would be just or reasonable and change or prohibit any practice, device or method of service in order to prevent discrimination; provided that it shall not reduce any rate, toll or charge within ten years after the completion of the railroad or plant to be used in the public service below a point which would prevent such public service corporation from making a net earning of 8 per cent on the cost of construction and equipment of such railroad or plant. The commission is to collect full and complete information on the value of all property owned and controlled by a public service corporation once a year, and to furnish the same to the board of public works for use in assessing taxes. A new tax is laid on public-service corporations in the shape of a special license fee, the amount of which is to be apportioned to the value of the corporation's property, and the tax in the aggregate must produce a revenue of $60,000 a year, which is appropriated for the support of the commission. The orders of the commission are reviewable by the Supreme Court of Appeals.

Going Value in the Buffalo Rate Cases

In the recent rate cases brought by the city of Buffalo against the Cataract Power & Conduit Company and the Buffalo General Electric Company before the New York Public Service Commission for the Second District, the proper method of arriving at going value or going-concern value was discussed at length.

The Cataract company made several claims for going-concern value, according to the differing views of its own experts. These claims were severally as follows: $350,400, or 10 per cent of reproduction cost of physical property; $996,000, on the value of the created or existing income theory, and $300,000, on the basis of 0.75 cent per watt of connected load. In the other case the Buffalo General Electric Company claimed a going-concern value amounting to $1,200,000. In neither of the cases was any of these claims approved or conceded by the commission, for the reason that under any of the admissible theories it was found that the stockholders have already been more than amply compensated through profits and dividends hitherto paid and equities in the properties accumulated out of surplus earnings.

The opinion held that there is a fundamental distinction, upon principle, as to going-concern value, between rate cases and appraisals for purchase or sale. It was held that going-concern value is inherent in the method of appraising a plant at its reproduction cost, for such a value could not exist without reasonable net earnings to support it; in the opposite event it would be worth much less than the reproduction cost and in the extreme case of no earnings would be worth no more than the scrap value realized by dismantling the property. The earnings themselves were held to have no bearing whatever upon going-concern value in a rate case, since the earnings are directly in question and their amount remains to be fixed by the decision of the regulating board.

Upon applying the other rules sometimes used to determine the so-called going value, such as early losses, cost of building up the business to a basis of reasonable profit, deferred dividends, etc., the commission found that the cost of attaching business had been charged to operating expenses and the net earnings throughout the company's existence had been as a whole so large as more than to offset any claims for allowances of this character. The opinion also held that such losses do not in any case constitute a property right and therefore are no part of the property value, although they may in some cases form the basis of claims which have a reasonable foundation. The arguments given in the opinion are supported by citations from a number of well-known rate cases decided by state and federal courts.

Public Service Commission News

Wisconsin Commission

In a decision recently announced the Wisconsin Railroad Commission has ordered a physical connection to be made between the toll lines of the Wisconsin Telephone Company and the La Crosse Telephone Company at La Crosse. The matter was brought before the commission upon petition of certain subscribers of the La Crosse Telephone Company who alleged that public convenience required the physical connection between the exchange systems of each company and the toll lines of the other. The case has attracted considerable attention among telephone men, as it is the first contested case of any importance to come before the commission under the recent legislative enactment providing for physical connection between telephone systems, and for the further reason that is in the nature of a test case for other cities in the State where similar conditions exist. There are two competing telephone companies operating in the city of La Crosse—the Wisconsin Telephone Company, a branch of the American Telephone & Telegraph system, and the La Crosse Telephone Company, the latter being owned and controlled by local capital. Because it is a local company and because of the conditions which gave rise to its installation the La Crosse Telephone Company has enjoyed a constantly increasing patronage and the Bell company has had a corresponding decrease in number of subscribers. Although the local company has more than twice the number of subscribers, its toll facilities are much inferior to those of the Bell system. The petition for a physical connection was vigorously contested by the Wisconsin Telephone Company on the ground that its local exchange would be deprived of its patronage and that irreparable injury would result if its extensive toll-line facilities were made available to the patrons of the competing company. In commenting upon the respondent's contention that the statute transgresses certain constitutional guarantees of property rights, the commission considered that the law was framed with the "view of protecting the utilities in the enjoyment of all of their legal rights and privileges, while at the same time compelling an involuntary enlargement of the use of their facilities when necessary and required for public welfare." In connection with this case it is remembered that at the time the physical connection bill was passed by the Legislature another law was enacted which had for its purpose the non-duplication of telephone exchanges in cities and incorporated villages. The two laws represent a compromise between the Bell and the independent interests.

The commission, after a careful review of the evidence, was of the opinion that a physical connection was required; that no irreparable injury will result to either party as the result of such connection, and that physical connection will not result in any substantial detriment to the service of either utility. Although no reference was made to rates, it was held that a subscriber of one company desiring toll service over the lines of the other company must pay in addition to the rate charged the patrons of the latter company a reasonable compensation for the additional service. Neither company is to be permitted to absorb the additional charge, but it must be paid by the patrons of either company. Although this will not result in any discrimination between subscribers of the same exchange, it will result in a just and necessary discrimination between the subscribers of the competing exchanges. The commission further orders that the expense of making such physical connections and the subsequent maintenance be apportioned equally between the two exchanges. Thirty days has been given in which to comply with the order. It is understood that the Bell company will carry the case to the Supreme Court.

The People's Water, Light & Power Company, of Mellen, has been authorized to issue $35,000 of stock to replace stock which was issued without the authority of the commission. The commission is in receipt of a complaint alleging that the Prairie City Electric Company refuses to furnish day service in the city of Prairie du Chien.

California Commission

The Railroad Commission of California issued a supplemental order on May 1 granting authority to the Oro Electric Corporation to do such work as might be necessary to keep alive its franchise in Stockton.

New York Commission

The Public Service Commission for the First District was notified that Governor Sulzer had vetoed the Silverstein bill relating to the change of motive power on the horse-car lines in New York City for the reason that he objected to the provision which would allow companies controlling horse-car lines to issue securities, practically without limitation, for the purpose of providing new equipment. The bill provided for the elimination of all horse-car lines in the city on and after Jan. 1, 1914. In connection with this bill inquiry was made at the office of the commission as to the number of horse-car lines now operated in the city of New York. It was there stated that when the commission was organized, July 1, 1907, there were in operation sixteen horse-car lines, but at present only six remain.

The application of the Consolidated Gas Company for authority to purchase 12,500 shares of preferred stock and 12,500 shares of common stock, or a majority thereof, of the New York & Queens Electric Light & Power Company, and for authority to acquire 6000 shares of the capital stock, or a majority thereof, of the New York & Queens Gas Company, made to the Public Service Commission for the First District on Jan. 18, 1912, came up for action before the commission. No final action was taken, but from the remarks of the commissioners it was indicated that the applications would be granted by a majority vote. Commissioner Milo R. Maltbie, to whom the matter had been referred, submitted an opinion in which he recommended that the application be granted in so far as it related to the acquisition of the stock of the gas company but that it be denied in so far as it related to the stock of the electric company. He claimed that the consolidation of gas and electric companies would tend to eliminate competition between the two kinds of service. Final action was deferred on account of the adoption of an amendment directing counsel to the commission to submit a clause for the final order which would compel the company to pay to minority stockholders the highest price paid for the stock already acquired. This amendment was adopted.

Current News Notes

"Charities That Soothe and Heal and Bless."—Following a rate war between the London (Ont.) Electric Company and the city hydroelectric department, the lighting rate to the different churches has been reduced to 3 cents per kw-hr.

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Central-Station Ice Cans as Garbage Receptacles.—An unusual piece of "good-will work" has been recorded at Hickman, Ky., by the Hickman Electric Light, Ice & Water Company. Recently new ice cans were installed in the factory, and as the old ones were no longer available for use by the company Mr. O. P. Moss, the general manager, promptly offered them to the municipality for use as garbage cans, for the lack of which the town had suffered considerably. The cans will be painted and placed at various points about the city, serving as a constant reminder of the desire of the company to co-operate wherever possible for the good of the community.

* * *

Record Run by Electric Roadster.—A remarkable run was made on May 5 by an electric roadster over the hilly course between Boston and Springfield, Mass., covering a distance of 93.4 miles in four hours and fifty-five minutes, or at an average speed of 19 miles an hour. The run was made on a single charge of the vehicle's battery, which consisted of fifty-four Edison "A-6" cells having a rated capacity of 225 amp-hr. The battery was three and one-half years old and delivered 295-amp-hr. on the run. Upon arrival at Springfield the machine was able without additional charging or boosting to continue to Holyoke and return, making the total run 114.7 miles. The machine was driven by Mr. P. E. Whiting, of S. R. Bailey & Company, makers of the vehicle.

* * *

Stock-Ticker Service in Chicago.—Inasmuch as the Western Union Telegraph Company contemplates discontinuing its sporting-news and stock-ticker service in Chicago, the Stock Quotation & Telegraph Company, of New York City, is applying for a franchise to supply similar service in Chicago. This company already operates stock tickers in several Eastern cities over wires which are leased from the Western Union Company. In its application for a franchise it requested the use of existing underground conduits and the right to connect with buildings in which the service is to be rendered, for which it agrees to pay the city $1 apiece annually for the maximum number of instruments installed at any time during the year. The aldermen think this compensation insufficient and have taken the subject under advisement.

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Fifteen Thousand Additional Flame-Arc Lamps Recommended for Chicago Street Lighting.—Execution of a contract with the Sanitary District of Chicago for installing 15,000 additional 10-amp flame-arc lamps or their equivalent was recommended by the Chicago City Council finance committee on May 16. The installation would cost a large sum of money and there is a question whether the city can finance it. In the discussion which took place at a meeting of aldermen the question arose whether the Sanitary District had sufficient generating units to supply energy to all of the additional lamps. The plan is to have the lamps installed and have them lighted from any source which may later be deemed advisable. If the proposed plan goes into effect, lamps will be placed at every street and alley intersection, spaced from 250 ft. to 350 ft. apart according to the density of population. Series tungsten lamps will be installed in certain sections instead of flame-arc lamps.

Underground Structures in Chicago. — Alderman Fisher has introduced in the City Council of Chicago a resolution authorizing the Mayor to name a commission to investigate "underground Chicago" and report a comprehensive plan for caring for the pipes, wires, conduits, tunnels and other public and private utilities which are operated underneath the surface of the streets.

* * *

Selection of Explosives.—Mr. Clarence Hall and Mr. Spencer P. Howell are the authors of a bulletin, No. 48, issued by the United States Department of the Interior, Bureau of Mines, referring to the selection of explosives used in engineering and mining operations. The bulletin deals with the characteristic features of the principal explosives and is one of a series dealing with tests of explosives and methods of reducing the risks involved in their use in mining work.

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Electricity's Part in West Virginia's Golden Jubilee. —A unique ceremony in connection with the celebration of West Virginia's golden jubilee at Wheeling, June 15 to 21, will be the commemorative service at 12 o'clock on June 20, the State's natal day. The lines of all the transportation, telegraphic and telephone corporations will be turned over to the State at that hour. These wires are to be connected with a mammoth receiving board, into which the President of the United States, the Governor of the State, the speakers of the day, the poet who composed the ode, and others participating in the program, will speak. Their voices will be carried over these wires to every city and village of the State, where similar appliances are to be installed which will reproduce the entire program.

* * *

Huge Electric Crane.—At the shipbuilding yard of Blohm & Voss at Hamburg, Germany, a huge crane has been erected for use in fitting out the *Vaterland*, sister ship of the *Imperator*. It has a lifting capacity of 250 tons. The forward arm of the jib, which has a total length of over 315 ft., can be raised to a height of 330 ft. above water level. There are two independent lifting appliances, a crab, which can lift 250 tons at a radius of 113 ft. or 110 tons at 175 ft., and a revolving traveling crane, which can run the entire length of the top of the main jib. This auxiliary crane can lift 10 tons at a distance of 240 ft. from the turning center of the main crane, an area of practically 182,920 sq. ft. being served by it. Only two men are required for controlling the crane, which is driven entirely by electricity.

* * *

Electrical Exhibition at University of Michigan.— An electrical exhibit was given by the students and faculty of the engineering department of the University of Michigan at Ann Arbor on May 15 and 16. The illumination display consisted of several types of electric-arc and incandescent lamps, equipped with various reflectors. Comparisons were shown between the light distribution of direct and indirect fixtures in the photometric exhibit. Through the courtesy of the Eastern Michigan Edison Company, a modern electric kitchen was equipped with improved heating and cooking utensils. A miniature three-phase electric locomotive designed by Prof. C. L. De Muralt and built by students in the engineering shops operated on a track 100 ft. long near the engineering building. An automobile equipped with an electric starter, the patents on which are held by Prof. Benjamin F. Bailey, was also on exhibition. One of the features of the exhibit was a combined miniature water-power generating station and irrigation system which was constructed under the supervision of Prof. H. W. King. On a space about 14 ft. square was an imitation mountain with streams running down the valleys, the water from which was dammed up behind masonry structures corresponding to the famous Roosevelt Dam. The water was conveyed through a miniature generating station and then allowed to spread itself over the plains below, through irrigation ditches. Automatic and manual telephone systems and telegraphic instruments for communicating messages with and without wires were also shown.

* * *

SOCIETY MEETINGS

Meeting of Efficiency Society.—The next monthly meeting of the Efficiency Society will be held on Tuesday, May 27, at the Aldine Club, 200 Fifth Avenue, New York. The general topic will be "Office Efficiency."

* * *

Annual Dinner of Colorado Electric Club.—The annual dinner of the Colorado Electric Club was held on May 8 at the Albany Hotel, Denver, Col. Over 500 members, including ladies and guests, were in attendance, and Messrs. J. Monroe Markley, of the Redpath Lecture Bureau, and Willis V. Elliott, district attorney, were the speakers.

* * *

Electric Vehicle Association.—At the regular monthly meeting of the Electric Vehicle Association to be held in the Engineering Societies Building, New York, on May 27, Mr. H. M. Martin, of the H. C. & A. I. Piercy Contracting Company, will present a paper entitled "The Ideal Electric Garage." The meeting will be called at 8 p.m.

* * *

Demonstration of "Light and Art."—Mr. M. Luckiesh, of the Physical Laboratories of the National Electric Lamp Association, Cleveland, Ohio, presented his "show," as he calls it, entitled "Light and Art," before the Chicago Section of the Illuminating Engineering Society on May 14. The chairman of the society, Mr. F. A. Vaughn, of Milwaukee, drew an analogy between art and music, saying that the composer of music depends on the technique and skill of the player to secure the proper effect from the music, just as the artist, sculptor, etc., depend on the illuminating engineer for the proper impression being conveyed by their work. Mr. P. S. Millar, of New York, president of the society, said that the effects produced by Mr. Luckiesh's "show" suggested the possibilities in the evolution of illumination.

* * *

New York Companies Section, N. E. L. A.—At the meeting of the New York Companies Section of the N. E. L. A. Mr. Arthur Williams, general inspector of the New York Edison Company, spoke on "Welfare Work." Commenting on the present wave of social unrest, striking proofs of which are afforded in the recent disturbances in Lynn, Mass., and Paterson, N. J., Mr. Williams explained that the solution of the problem caused by this state of mind among the workers was the making of partners out of them. He said that "about twenty years ago a painter in France came to the conclusion that it was eminently unfair for him to take a large part of the earnings of his twenty employees from week to week. No matter what wages he paid, there was always something at the end of each week that these men left with him. Thereupon he conceived the brilliant idea of taking the men into partnership with him, and from that has come the idea of profit-sharing among employees, service annuities and other kindred plans." Mr. Williams then enumerated some of the advantages to be derived from membership in the New York Edison Savings and Loan Association, which is conducted under the auspices of the company and has all expenses paid by the company and not from the savings of the association. Although just about a year old, the association now has a membership of about 900, with a total surplus of about $38,000 invested in mortgages.

Electrical Equipment of Industrial Plants

Illumination, motor requirements and telephone-call system of the Continental Motor Manufacturing Company, Detroit, Mich. By Harry C. Spillman

IN designing electrical equipment for factories little attention is given to future growth, and very soon the owner finds that the feeders are too small and must be reinforced. This leads to other complications, and a little later the wiring is in such a tangle that an expert must be employed to straighten matters out, and usually he recommends an entirely new electrical installation. All of these matters can be avoided by a little foresight in the original layout. The rule-of-thumb principle cannot be made use of in this work if satisfactory results are desired; moreover, when an installation is carefully laid out there need to be no changes and alterations during the installation, as mistakes can easily be corrected on the drawing board.

A great amount of thought and foresight was exercised in the planning of the new Detroit plant of the Continental Motor Manufacturing Company, which has resulted in its being a model installation and affording an excellent example of modern electrical work.

Three-phase, 60-cycle current at 220 volts is used for motors and 110-volt, single-phase current is used for the lighting. The low voltage was adopted in preference to a higher value because of the fact that the power house is located in a central position in respect to the factory buildings and the greatest transmission distance, taking in consideration the future extensions of the buildings, is less than 600 ft. A higher voltage would be more or less dangerous for an industrial plant, and there would be a great deal more trouble from grounds.

The switchboard at the power house has separate panels for lighting and motor service, and each building has its separate circuits for each purpose. This arrangement has many advantages, as each building is electrically independent and trouble in any one circuit does not affect the others. Tests can easily be made, and measurements of energy consumption are simplified. Small plug switches on the switchboard connect the power-factor meter and indicating wattmeter to any circuit to show the actual load condition for any building. All the buildings are connected to the power house by means of a large tunnel, one side of which is used exclusively for the electrical feeders, each circuit being placed in a steel conduit which protects the wires from rough usage such as they generally receive in manufacturing plants.

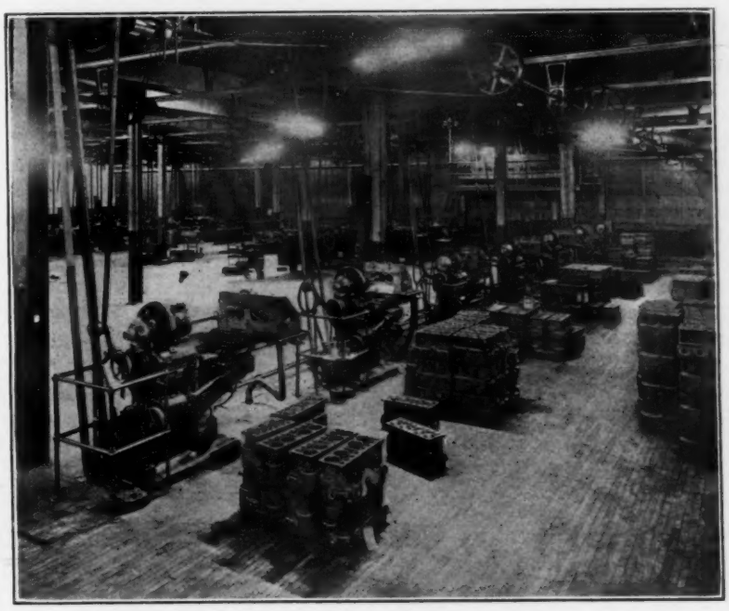


FIG. 1—ILLUMINATION OVER SPECIAL GRINDING MACHINES

The wire used for the entire installation is double braid with 20 per cent Para and was furnished by the American Steel & Wire Company. Soon after the wiring was installed there was a heavy flood and all the circuits in the tunnel were submerged for four days. After the flood receded it was discovered that the steel conduits were filled with water. After having been carefully drained the circuits were tested for grounds, but not a single ground or case of trouble developed. Dossert joints are used for every connection. This plan is of great assistance in case of any trouble. A line can be easily disconnected and replaced without cutting the cables, making splices or resoldering.

The circuit for motor service in the machine shop consists of two 500,000-circ. mil cables for each leg of the circuit connected through a 2000-amp I-T-E circuit-breaker. From the large distribution board erected on a balcony the operator has a full view of the entire room. This board is made up of ten panels, containing, besides the 2000-amp circuit-breaker, eighteen double-throw, three-pole oil switches with the handles on the front of the board. Each motor is controlled by one of these switches with a no-voltage release and two adjustable overload coils so arranged that a bell rings in case the switch opens by overload. Each one of these oil switches can be opened from a distance by the use of a push-button placed near the motor, which can be stopped immediately in case of accident. This scheme allows all the motors in the machine shop to be started at a central point and places the entire control of the motors under one man.

The group-drive arrangement is used in the machine shop, each department having its independent line shafting and motors. All branches to motors are run in steel conduit, and the entire system is made neat and attractive by the use of condulets.

A 500,000-circ. mil circuit is run from the power house to each of the remaining buildings. These circuits are connected to cabinets which are located near the centers of the buildings, and the motor circuits are extended from these cabinets to the motors operating different groups of machines. These cabinets are made of No. 10 gage steel and are slate-lined; the panels are mounted on slate and have inclosed-fuse branches for the motors.

As a rule, the selection of the proper size motor is a matter of guesswork, which results in using motors entirely

too large for the requirements. This leads to more or less trouble for manufacturers operating their own power plant and using polyphase alternating current. The greatest trouble in using too large motors is poor regulation and a low power-factor, which reduces the efficiency of the generators and causes excessive line loss. By careful planning the motors in this plant were selected so as to operate between three-quarters and full-load rating. On this account the power-factor for the entire plant is 84 per cent, which is unusually good for an industrial establishment. Investigations have shown that in most industrial plants using induction motors the power-factor is about 60 per cent. Use is made of Wagner motors covered by a guarantee of a continuous overload capacity of 25 per cent. Small motors are controlled by a special switch made by the Detroit Fuse Company, and the large ones by General Electric controllers with adjustable overload relays and no voltage release, which eliminates fuses at the motors. All the motors are mounted on a suitable platform, supported either from the concrete columns or the roof trusses. The platforms are made in one piece so that motors can be lifted off and the platforms removed from the metal bracket, which allows the motor to be lowered. In case a motor is working unsatisfactorily it can be removed and a new one installed in less than fifteen minutes. In order to make quick electrical connections Dossert joints are used at the motors. Careful tests are made of the motors every month so that the load conditions are known and a smaller or larger size motor can be installed as needed so that each motor may be correctly loaded as nearly as possible.

Much thought was given to the illumination of the factory so that each department would have sufficient light of the right kind. Each building has its own three-phase feeder, supplying energy at 220 volts to the building, where it is transformed to single-phase and 110 volts by means of balance coils. It was found that the saving in first cost over 220-volt tungsten lamps would more than pay for the balance coils. Moreover, the 110-volt lamp is more rugged than the 220-volt unit.

The lighting panels are for 110-220-volt, three-wire single-phase system controlled by knife switches with inclosed fuses. The cabinet boxes are made of No. 10 gage sheet metal with reinforced corners provided with a 3-in. gutter. The panels are made of 0.5-in. Monson black slate with the valleys of 0.5-in. slate strips properly drilled for branch wires and slotted for the main feeders. The switches are of double-pole, single-throw type with 30-amp rating and 250-volt spacing and provided with rubber handles. These cabinets are distributed along the side walls of the buildings so that the length of the branch circuits do not exceed 100 ft. Three-quarter-inch conduit leads from these cabinets, each containing three double-braid duplex wires. Condulets are used at each outlet so that future extensions can be made in any direction at each condulet. The conduit is fastened

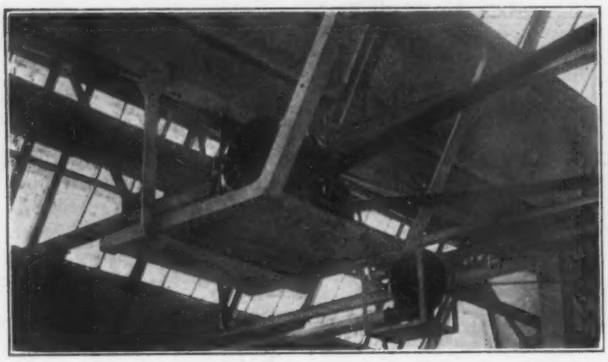


FIG. 2—MOTOR STANDS IN BUILDINGS WITH SAW-TOOTH ROOFS

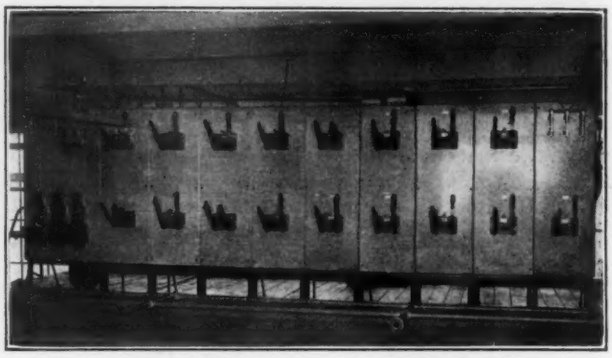


FIG. 4—STARTING SWITCHES FOR MACHINE-SHOP MOTORS

FIG. 3—SUB-ASSEMBLY ROOM LIGHTED BY TUNGSTEN LAMPS

FIG. 5—LATHE-ROOM ILLUMINATION BY TUNGSTEN LAMPS

at 6-ft. intervals in the concrete ceilings by means of pipe straps and lead anchors.

One-hundred-watt tungsten lamps with enameled steel reflector with a green exterior are used in the offices, assembly room, stock room, receiving room and tool room. These rooms have 13-ft. white ceilings with which a tungsten lamp proves most satisfactory. The lamps were spaced on 10-ft. centers in the office and assembly rooms and were suspended 9 ft. from the ceiling. With the lamps at this spacing operating at the middle voltage, photometric readings show an average of 5.4 ft.-candles at the working plane, which is 30 in. from the floor. The illumination is very uniform and varies only 0.4 ft.-candle throughout the factory.

Special attention was given to the spacing of the lamps in the tool room over the machines, so that the operator would have strong light without shadows. This plan has been carried out so perfectly that the operator has 7 ft.-candles at the working plane, and the workmen in this room have not requested a single extension cord or desired to have any of the lamps changed. In the stock room use is made of three lamps between each steel bin, each lamp being controlled by a pendent switch. In the remainder of the stock room the lamps are spaced on 10-ft. centers.

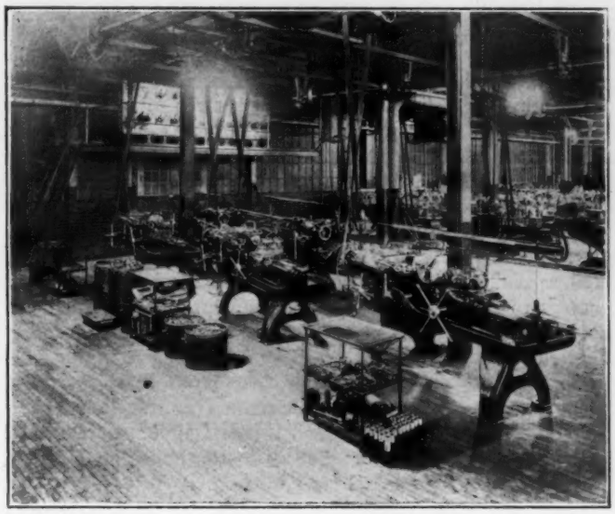


FIG. 6—ILLUMINATION IN MACHINE SHOP

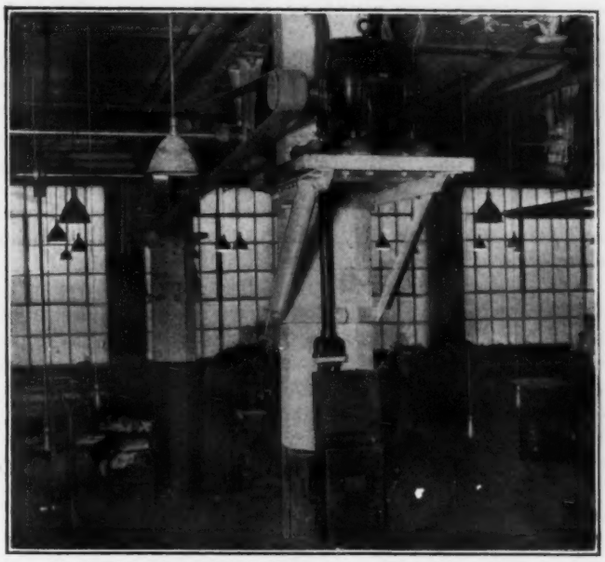


FIG. 7—MOTOR PLATFORMS ON CONCRETE COLUMNS

The machine-shop roof is of saw-tooth construction having the columns spaced on 20-ft. centers; the bottom of the roof trusses is 14 ft. from the floor. Cooper Hewitt lamps with white reflectors are used in this room. Each lamp consists of a 50-in. tube placed 12 ft. from the floor; the spacing is 40 ft. It is 20 ft. between each row of lamps, which are staggered with reference to the next row. This arrangement gives 6.3 ft.-candles at the working plane with a consumption of only 0.49 watt per sq. ft. floor area. The entire machine shop is operated without the use of extension cords. The mercury-vapor lamps provide an excellent light for reading blueprints. These lamps have been operating for nearly a year, and not a single tube has been replaced.

The power house is illuminated with Cooper Hewitt lamps with red reflectors, which give nearly white light. These lamps are suspended from the roof trusses 30 ft. from the floor, thereby affording a very strong illumination.

Owing to the large amount of smoke and the great distance to the roof trusses, flaming-arc lamps are installed in the motor-test room and heat-treatment building. Yellow electrodes are used in these lamps, as the yellow light possesses the property of penetrating the smoke. These lamps

FIG. 8—ILLUMINATION IN GRINDING DEPARTMENT

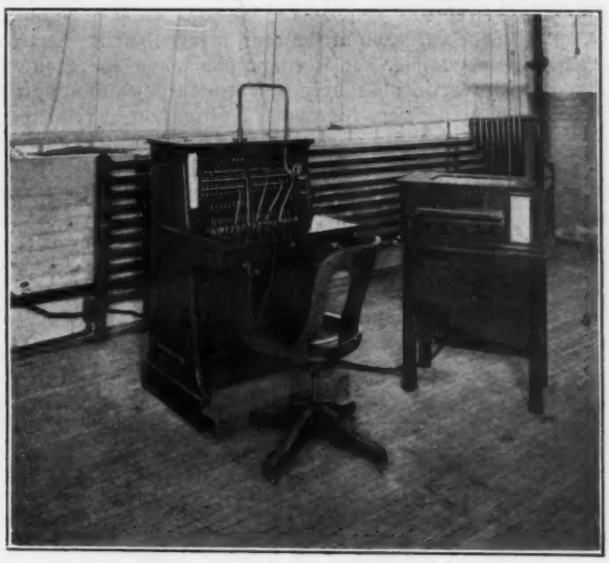


FIG. 9—AUTO-CALL AND TELEPHONE SWITCHBOARD

are placed on 20-ft. centers and are staggered so that a fairly uniform distribution of light is obtained. Extension plugs are also installed for the inspection of motors. Careful records show that the electrodes in these lamps burn 107 hours per trim.

The entire telephone system throughout the plant is connected to the Bell system, which allows every telephone an outside connection. The telephone system passes through the private branch exchange board, which is under the control of the operator. In case the person called is not at his desk an "auto-call" system in charge of the telephone operator rings a signal throughout the plant and yards until this person answers the nearest telephone. With this arrangement it is possible to locate a person within an average time of three minutes. Formerly this work was done by a messenger boy at an average of seventeen minutes. There is also connected to the same call system a program clock which rings at starting and quitting time. This auto-call is also connected to the telephone system at night and on Sunday to notify the watchman in case of a telephone call. Thus the department heads can get in touch with the factory at any time.

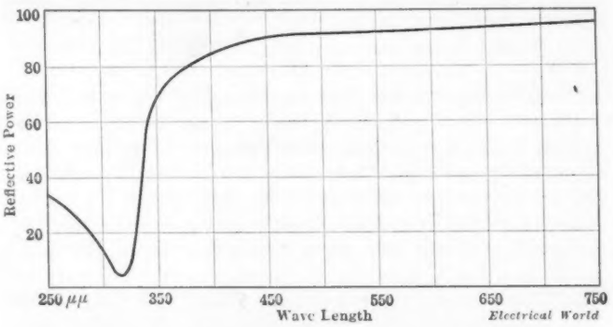
Silvered Mirrors and Their Preservation

By Dr. Louis Bell

For most technical laboratory work requiring the use of reflecting surfaces one is fortunately able to use glass mirrors silvered on the back, like the ordinary commercial product, and hence giving very little trouble from depreciation of the reflecting power. One is not justified in assuming, however, that a mirror constant once determined will remain indefinitely the same, and changes of small amount —an amount greater, however, than is to be accounted for by the condition of the outer glass surface on the mirror front—are quite possible. There is a necessary loss by reflection at this free surface of the order of magnitude of 4 or 5 per cent, an amount which will vary materially with the thoroughness of the cleaning to which the mirrors are subjected prior to use. With thorough cleaning, however, the variation at the front surface is practically negligible. Frequently the variation at the rear silvered surface is also practically negligible, but it cannot be taken for granted that it will remain absolutely uniform through months or years of use. In a very thorough investigation of reflecting powers Chant[1] found a variation of 2.6 per cent, which is too large to be accounted for simply by observational errors, in the coefficient of a mirror silvered on the back after three months. Just what the cause of such a change may be is not fully determined. It may be due to deterioration of the film by reason of imperfect cleaning of the surface on which it was deposited, or possibly it may be the effect of lack of backing or improper backing of the film causing a change in its reflecting properties.

For certain purposes, however, it is desirable to use the actual metallic reflecting surface of a mirror silvered on the front; for instance, in some reflecting instruments the added sharpness of such a reflection is a material advantage and in experiments in radiation the absorption of the glass when a mirror is silvered on the back is highly objectionable. Ordinary plate glass, for instance, absorbs most of the radiation up to a wave-length of about 320 μμ and also produces some strong absorption in the infra-red part of the spectrum where the silvered film itself has enormously high reflecting power.

For silvering mirrors a considerable number of processes have been tried, a very good résumé of which has been given by Curtis[2]. Any of these can be made in careful hands to give good results, the two most popular in this country being those of Brashear and Lundin. In the writer's judgment the success of any of the methods depends chiefly upon the perfection of the cleaning of the glass. If the cleaning is done with extreme care, almost any of the silvering solutions and reducing agents will give a good coating, although all the processes are sensitive to temperature in ways not yet clearly understood. For most purposes it is best to work for a fairly thick coating in order that the surface may stand polishing. Thin coats of silver transmit a very material amount of light, which lowers the intensity of the reflected beam; for example, one very beautiful coating tested by the writer, a coating too thin to burnish, showed a reflecting power of only 73.8 per cent from the silvered face. It showed a transmitted beam of 10.2 per cent, uncorrected for the very slight reflection at the free glass surface after the beam had been transmitted through the silver coating. The color of the film in this case was pale violet gray when the film was held against the sky, and the apparent transparency was very striking. To stand polishing, the films should be thick enough to transmit the light from an incandescent filament only very faintly, when the loss by transmission becomes negligibly small. Unless the mirror surface is highly polished there is an unmistakable loss from scattering, the silver film being to a certain extent granular in surface. Polishing seems to smear down the soft silver surface into metallic luster and on the success of the polishing depends



REFLECTING POWER OF A SILVER SURFACE

the ultimate coefficient of reflection. Polishing is usually done with a very soft bit of leather made up into a loose ball over cotton and touched with a barely perceptible amount of the very finest rouge. Fresh silvered surfaces thus polished may have reflection coefficients as high as 94 or 95 per cent at normal incidence in the visible spectrum, as has been shown by Hagen and Rubens and also by Chant. It is extremely difficult to get so perfect a polish as to give such results.

Various mirrors tested by the writer, polished by various skilful hands, have generally shown coefficients of from 84 to 87 per cent, with the tungsten lamp as the light source. Chant's high results were obtained with a Hefner lamp, which from the predominance of the reddish rays would necessarily give a slightly higher reflecting power. The difference due to this cause could, however, hardly exceed 1 per cent, so that it is clear that care in polishing is a very essential matter if a high coefficient is to be obtained.

Incidentally, it should be mentioned that in a particular region of the ultra-violet, between the wave-lengths of 330 and 300 μμ, silver is a uniquely bad reflector, as the subjoined curve shows. At its minimum it is scarcely as good as black paper would be. For obtaining a surface good in reflecting the extreme ultra-violet one does better to abandon silver and use either a silvered mirror nickel-plated according to a process suggested by Wood[3] or a metallic mirror wholly of, or surfaced with, nickel. At the

[1] *Astrophysical Journal*, Vol. XXI, page 211.
[2] *Popular Astronomy*, Vol. XIX, pages 327, 398.
[3] *Astrophysical Journal*, December, 1911.

point where silver utterly fails nickel has a coefficient of about 45 per cent. Metallic nickel polishes very badly in the rolled or cast state, and a better surface can undoubtedly be obtained by an electrolytic deposit on metal to which is subsequently given as high a polish as possible. When fresh, Mach's alloy gives a much higher coefficient but is difficult to preserve from deterioration. Silvered surfaces deteriorate under ordinary laboratory conditions with exasperating rapidity and may in a few weeks fall in reflecting power by 20 or 30 per cent or more. The following test recently made by the writer is a case in point.

A certain silvered mirror gave initially a coefficient of 84.5 per cent. After fifteen weeks' exposure—during the first month being merely laid away unprotected from dust and the rest of the time placed on edge in a somewhat damp and dusty cellar—the coefficient had fallen to 39.8 per cent and the mirror had acquired a golden-brown tinge of very considerable intensity. To prevent this deterioration, often even more rapid and destructive than that here noted, the writer has recently been trying the process suggested by Perot[1] for coating the silver surface with an extremely thin film of collodion. Collodion is easily obtainable in amyl-acetate solution, and lacquers of very similar character are used commercially for the preservation of the polish on fine silverware.

A mirror similar to the one just mentioned, which initially gave a coefficient of 86.3 per cent, was flooded with such a solution, the thing actually used being one part "Lastina" lacquer, extra clear, diluted with two parts of the "thinner" provided for commercial use with it. This leaves faint and broad color interference bands due to the film, probably in this case, as in Perot's experiments, somewhere nearly 1 wave-length in thickness. After the film was dry, which consumed only an hour or so, the mirror was again tested for reflective coefficient, and the value obtained was 82.6, so that the actual loss of light due to the film was in the vicinity of only 4 per cent. The mirror was then exposed alongside its mate for fifteen weeks and on testing at the end of the period showed a coefficient of 70.2 per cent in spite of the results of some accidental handling. It exhibited no change in color, the film being as white as it was at the start. Some experiments were later tried with the same lacquer, diluted this time with six times its volume of "thinner," on one of the large diagonal flats used on a 2-ft. reflector at the Harvard Observatory, and the series of tests made there by Mr. E. S. King showed that there was no perceptible injury to the definition. The photographic star images through the film were apparently as sharp as without it. Finally the same process was applied to the 2-ft. parabolic speculum itself. The definition was apparently unimpaired, and after three months of regular service the lacquered silver film has not changed color nor lost a material amount of its brilliancy, while an unprotected coating usually is quite unfit for service in a decidedly shorter time than this. The lacquer coating is easily washed off with the "thinner," and if the film underneath has deteriorated there is no reason why it should not be repolished and a fresh coating then applied. At all events, the Perot process carried out by means of the commercial lacquer seems thoroughly successful. It is altogether probable that the same process applied to a mirror of Mach's alloy would keep its surface in condition for a long period, and so thin a film would produce scarcely perceptible absorption except in the region approaching 200 μμ, beyond which the most extraordinary precautions have to be taken. The solution is applied by pouring a liberal quantity quickly upon the mirror surface, tilting it about to make sure the surface is fully covered, and then tipping the mirror quickly on edge to drain and dry. The process is best carried out in a fairly warm and dry room as free from floating dust as possible.

[1] *Comptes Rendus*, November, 1909.

The Theoretical Basis of the Multiple-Rate System

By Hugo E. Eisenmenger

I. Variability of the Specific Demand Charge

It is now generally recognized that a sound and equitable system of rates for electric service should not only take into account the kilowatt-hours consumed by the customer but also the capital investment which the customer causes to the central station. This latter value is largely determined by the demand of the customer at the time of the central station's peak load (which is called hereafter the customer's simultaneous peak"), and since it is impossible to measure the individual customer's simultaneous peak in a commercially practicable way, usually the customer's maximum demand is taken instead, regardless of the time when it occurs, the assumption being that for a certain class of customers the ratio of maximum demand divided by demand during peak generally does not vary much for the individual customer from the average corresponding ratio for that class.

This means that the amount a of the customer's bill under this system of rates is composed of two parts, the first one, Y, the demand charge, being proportional to the customer's demand d, and the second, Z, the energy charge, being proportional to the energy consumed, e. Thus:

$$a = Y + Z, \quad Y = yd, \quad Z = ze$$
$$a = yd + ze, \qquad (1)$$

where y is the demand charge per kilowatt of maximum demand (to be called specific demand charge hereafter

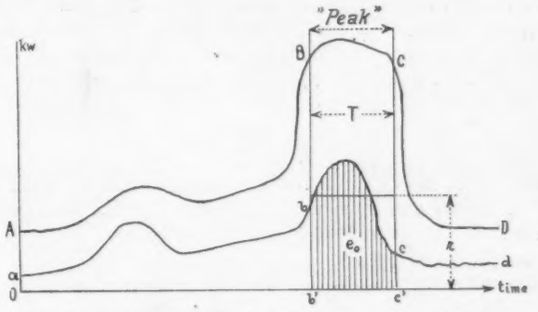


FIG. 1—LOAD CURVES OF STATION AND CONSUMER

and z is the energy charge per kilowatt-hour (specific energy charge); y is given in cents per kilowatt of maximum demand and z in cents per kilowatt-hour.

According to the usual assumptions, y and z are constants for a certain class of business (for instance, residence), and that would be correct if the central station's peak load were assumed to last only for one moment, for one differential of time. In practice, however, the investment is determined not only by the instantaneous maximum but also—at least as far as the necessary size of the central station is concerned—by the average maximum demand over a longer period, for instance, one or two hours, or whatever length of time the load curve shows an ordinate practically equal to the maximum ordinate. Any load that comes on during this period comes "on peak." The customer's simultaneous peak, therefore, is more properly his average demand during the period of the central station's peak load, and whenever the term is used hereafter in this article it will be in the sense of this latter definition. In other words, the customer's simultaneous peak equals the number of kilowatt-hours used by the customer during the central station's peak-load period divided by the duration of the latter in hours.

If now a certain duration of the central station's peak load is assumed, it will be shown in the following that it is no longer theoretically correct to use a constant for the specific demand charge. In order to get down to the fundamentals of the problem, assume first that it is possible to determine a customer's simultaneous peak r, and to base

the specific demand charge y' thereon, instead of basing it on the absolute maximum demand. In the new case,

$$a = y'r + ze \qquad (2)$$

That part $y'r$ of the total bill which represents the demand charge is proportional to the customer's simultaneous peak, and if the specific demand charge y' is based thereon, it will be a constant. In practice, however, as explained

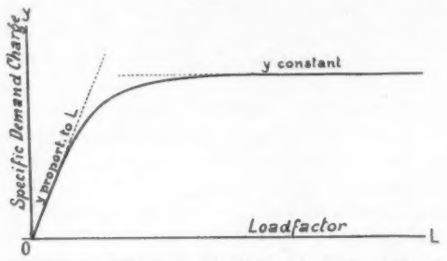


FIG. 2—SPECIFIC DEMAND CHARGE PLOTTED AGAINST LOAD-FACTOR

above, it is necessary to base the specific demand charge on the maximum demand, and if the total demand charge shall be the same in both cases, $dy = ry'$, where $y' =$ constant, or

$$y = \frac{ry'}{d} \qquad (3)$$

If $A\,B\,C\,D$ (Fig. 1) is the central station's load curve and $a\,b\,c\,d$ be the load curve of an individual consumer, and if, further, $b'c'$ be assumed as the duration T of the central station's peak load, then the consumer's simultaneous peak r is given by the height of the rectangle into which the area $b'b\,c\,c'$ can be converted over the basis $b'c'$. Then it will be possible to write

$$r = \frac{e_o}{T} \qquad (4)$$

where T is the duration of the central station's peak load $b'c'$ in hours and e_o is the area $b'b\,c\,c'$ or the energy consumed in kilowatt-hours by the customer during the period T.

Equation (4) can be written in the following form:

$$r = \frac{e}{d} \times d\,\frac{e_o}{e} \times \frac{1}{T}$$

or

$$= L \times d \times \frac{e_o}{e} \times \frac{1}{T}$$

where L is the load-factor expressed as equivalent number of hours' use of the maximum demand per month (or per day, according to the period over which e is taken) and

$$\frac{r}{d} = L\,\frac{e_o}{e} \times \frac{1}{T}$$

Substituting this in equation (3),

$$y = L\,\frac{e_o}{e} \times \frac{y'}{T} \qquad (5)$$

where $\frac{y'}{T}$ is a constant for a given central station with a given shape of load curve.

The specific demand charge y will therefore be not constant but directly proportional to the load-factor L, provided $\frac{e_o}{e}$ does not change with changing L. It is easy to see, however, that $\frac{e_o}{e}$ does change with changing use of the demand, and a little investigation is necessary to ascertain how the ratio $\frac{e_o}{e}$ is likely to vary under such conditions.

If the load-factor is very small—for example, thirty minutes' use, or less, per day—it is hardly likely that the whole installation is in use but a few minutes per day and completely idle the remainder of the time. The reason for the small load-factor will rather be found, in the majority of cases, in a large maximum demand of very short average daily duration—probably not an everyday maximum and perhaps occurring only once or twice a month. This short peak will be superposed on a load curve more or less of the character of the typical load curve for that class of consumers; in other words, the customer will have a number of lamps which are infrequently used, but which increase the maximum demand very decidedly. For instance, if a residence customer uses his maximum demand an average of fifteen minutes daily, it seems obvious not that he is really using his full installation for fifteen minutes day after day, but rather that he is using certain lamps in his house from day to day in the same manner as other residence customers, and at comparatively infrequent intervals uses a number of additional lamps, for some special occasion, which otherwise never are in use simultaneously. In other cases the explanation might be that the house is not constantly occupied, day by day. In both cases, however, it would seem that the ratio $\frac{e_o}{e}$ will not be materially changed from its average value for that class of business (residence) and may for a rough approximation be assumed constant and the same as with normal load-factors of that class.

On the other hand, an abnormally large load-factor is possible only by long hours of use. Residence loads, which as a class have a peak later than the central station's peak, are likely to have their load-factors increased, not by additional hours of use during the central station's peak load, but almost exclusively by additional use during the later hours of the evening. Such classes of business, on the other hand, as have their peaks during the central station's peak—such as offices, stores, etc.—can improve their load-factors *eo ipso* only by increased off-peak use. Therefore the ratio $\frac{e_o}{e}$ will, apparently, decrease with increasing load-factors, if the load-factor is large.

It seems evident, therefore, that for small load-factors $\frac{e_o}{e}$ is roughly constant, and consequently from equation (5) the specific demand charge y is approximately proportional to the load-factor, whereas with large load-factors $\frac{e_o}{e}$ is decreasing as the load-factor increases, thereby leaving the product $L\frac{e_o}{e}$ more or less constant, and therefore y, according to equation (5), does not change materially for larger load-factors. If the specific demand charge y is plotted against the load-factor, the result, therefore, should be a curve somewhat like Fig. 2.

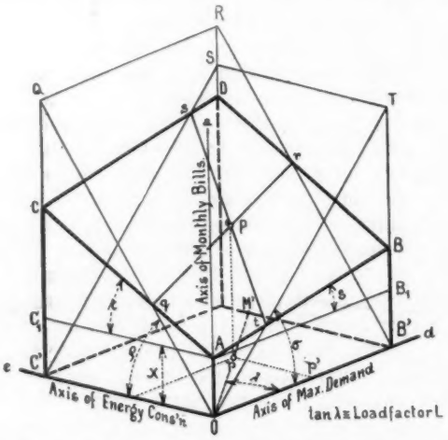


FIG. 3—GEOMETRICAL METHOD OF REPRESENTING CHARGES IN A RATE SCHEDULE

II. THE EXPRESSION OF VARIABLE SPECIFIC DEMAND CHARGES IN THE RATE SCHEDULE

The problem of how to express these variable specific demand charges in a rate schedule is most conveniently treated graphically along the lines described in the author's article, "Space Representation of Central-Station Rates," in the *Electrical World*, Nov. 4, 1911. A system of rectilinear solid co-ordinates will accordingly be chosen, representing the customer's maximum demand d and his kilowatt-hour consumption e as horizontal co-ordinates and the amount of his bill a as the vertical co-ordinate.

In order to deal with more general conditions, assume a system of charges of which the above is only a special case, namely, the three-charge system, which charges each customer, besides the energy and demand charges, a certain fixed amount x equal to the customer or connection charge. Equation (1) then becomes

$$a = x + yd + ze, \qquad (1a)$$

where x is a fixed amount, expressed in cents per month.

If now x, y and z are taken as constants, the geometrical representation of equation (1a) is a plane in space in the general position $ABCD$ (Fig. 3). The distance OA equals the customer charge x; y and z are given by the tangents of the angles s and r respectively. The proof for this is given in the above article, but for those not familiar with that treatment, it may be briefly pointed out here that by placing in equation (1a) first d and then e, equal to zero, the equations of the traces AC and AB are at once obtained and these equations, $a' = x + ez$ and $a'' = x + dy$, demonstrate the correctness of the above statements about the geometrical representations of x, y and z.

Each customer's load is represented by a point on the bottom plane (Fig. 3), for instance p, where Op' is the maximum demand and $p'p$ is the kilowatt-hour consumption. The load-factor $\frac{e}{d}$ is proportional to the tangent of the angle $B'OM'$.

Let it now be assumed that smaller specific demand charges are wanted for smaller load-factors, and vice versa, as already developed. If all customers with a load-factor below a certain value, tan $B'OM'$ (Fig. 4), are charged a constant demand charge $y_1 = \tan s_1$, and if for larger load-factors the demand charge is increased to $y_2 = \tan s_2$, and furthermore, if the customer charge x and the specific kilowatt-hour charge z remain constant for any size of the load-factor, then the locus of customers' bills under all conditions of consumption, demand and load-factor is shown in Fig. 4 in heavy outlines.

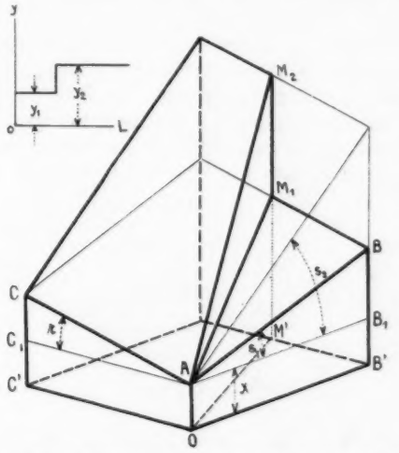


FIG. 4—GRAPHIC REPRESENTATION SHOWING LOCUS OF CUSTOMERS' BILLS

If now, instead of using only two steps in the demand charge, the number is increased, the result will be typified by Fig. 5, and it is easy to see that by a continual increase of the number and corresponding decrease in the size of the steps, a continuous curved surface, of conical character like Fig. 6, will replace the original series of planes. The nature of the directrix BB_1 or mn of this surface depends entirely on the functional relation between the specific demand charge and the load-factor.

Now let the variable specific demand charge y be a function f of the load-factor, or $y = f(L)$, whereas the customer and kilowatt-hour charges are the constants x_0 and z_0 respectively; then

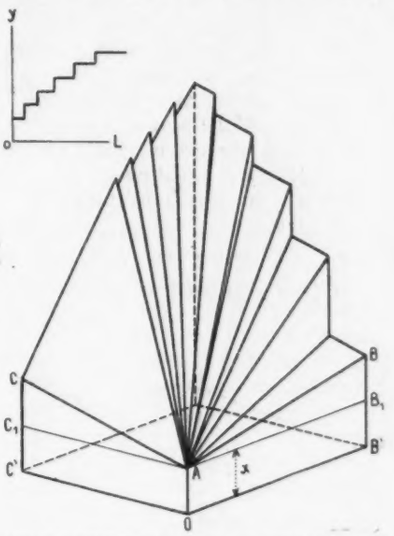


FIG. 5—GRAPHIC REPRESENTATION OF DEMAND CHARGE SHOWING RESULT OF INCREASE IN NUMBER OF STEPS

$$a = x_0 + d \cdot f(L) + ez_0 \qquad (6)$$

If now, for instance, $y = f(L)$ be chosen proportional to L, or

$$y = f(L) = k \cdot L, \qquad (7)$$

it follows that

$$a = x_0 + d \cdot k \cdot L + ez_0,$$

or, since

$$L = \frac{e}{d},$$

$$a = x_0 + (k + z_0)\, e. \qquad (8)$$

The variable demand charge in this case therefore is simply reduced to an additional kilowatt-hour charge; the total bill is independent of either load-factor or demand, and under the assumption made in this instance it follows that a demand charge can be expressed by an energy charge and vice versa.

For example, it might be specified in a rate schedule that a kilowatt-hour charge of 5 cents would be made and in addition a variable demand charge equaling (in cents per kilowatt of demand per month) twice the load-factor (in hours' use per month); this would simply mean a straight rate of 7 cents per kw-hr., as can be verified from equation (8) when $x_0 = 0$. A customer, for instance, having a 10-kw demand and 1000 kw-hr. of consumption would have a load-factor of 100 hours' monthly use and consequently pay a demand charge of $2 per kilowatt. His bill would therefore be:

10 kw at $2	$20.00
1000 kw-hr. at 5 cents	50.00
Total	$70.00

This would be equivalent to a straight rate of 7 cents per kw-hr.

If y be chosen so that

$$y = y_0 + kL \qquad (9)$$

then

$$a = x_0 + y_0 d + (k + z_0)\, e \qquad (10)$$

That means that if the demand charge as a whole is a

linear function of the load-factor, and if the other two specific charges are constants, the rate can be reduced to one which contains only constant specific charges, or, in other words, the curved surface typified in Fig. 6 is reduced to a plane. This reveals the very interesting fact that under certain assumptions the variation in one of the specific charges may be taken care of by a change of one of the other charges; in this case, for instance, the variation of the demand charge is compensated by adding a constant amount to the constant energy charge.

In order to establish the general relation between the shape of the curved surface and the function $f(L)$, intersect the surface with a plane normal to the axis of demand, at unit distance from the origin, for example, as shown at $m'mn'n$ in Fig. 6. The equation of the curve of intersection mn can be found by substituting $d = 1$ in equation (6), which gives

$$a = x_o + f(L) + ez_o$$

Now $L = \frac{e}{d}$ if L is expressed in hours' use of the maximum demand per month, and when $d = 1$, it follows that $L = e$ and therefore

$$a = x_o + f(e) + ez_o = f(e) + (x_o + ez_o)$$

This is the equation of the directrix mn of the curved surface in Fig. 6, lying in the plane $d = 1$.

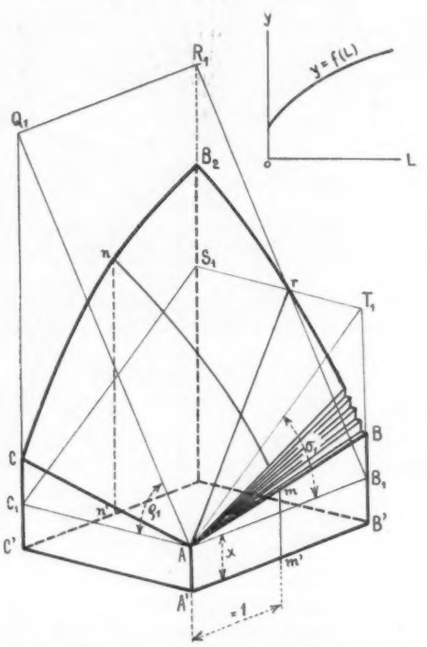


FIG. 6—SPHEROIDAL SURFACE GENERATED BY INCREASING NUMBER AND DECREASING SIZE OF STEPS

Therefore, if the function $f(L)$ showing the variation of the demand charge with the load-factor is known, the directrix, shown in Fig. 7, can easily be constructed by adding the ordinates of the straight line $(x_o + ez_o)$ to the ordinates of the curve $f(L)$. If $y = f(e) = f(L)$ is a linear function of e, as indicated in Fig. 7a, then the directrix will also be a straight line and the curved surface will become a plane (as shown above in another manner).

As regards the expression of a variable demand charge in a rate schedule, there are several different ways of doing this. Assume, for example, that the customer charge is constant, or $x_o = 50$ cents; that the specific demand charge is variable with the load-factor, according to the curve given in Fig. 9, and that the specific energy charge is constant at 2 cents per kw-hr.

First Method.—One way to express this rate would be by means of a schedule reading somewhat as follows: Each customer will be charged a fixed service charge of 50 cents per month; besides this a demand charge will be made for each kilowatt of the customer's demand as per the second column of the table, and a running charge of 2 cents per kw-hr. consumed. The table is simply a resolution of the curve in Fig. 9 into a table for the use of the customer. For each step in the table the demand charge represents the upper limit of the step.

This is the most obvious and natural way to express the

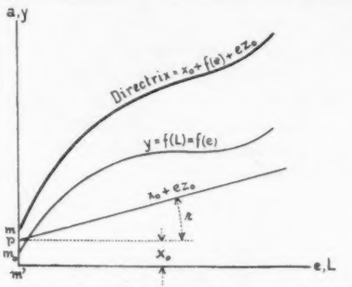


FIG. 7—DIRECTRIX CONSTRUCTED, DEMAND CHARGE AND LOAD-FACTOR BEING KNOWN

schedule but rather difficult for the ordinary customer to understand and less simple in application than other methods. Probably for this reason it is not in practical use—at least not to the writer's knowledge.

If a load-factor line be drawn on the conical surface referred to—that is, a line connecting all points with the same load-factor, as Ar in Fig. 6—the total amount of the bill (corresponding to the vertical ordinate), not counting the constant customer charge $A'A$, will be proportional to the maximum demand and also to the kilowatt-hours of consumption and can be expressed therefore in terms of dollars per kilowatt or dollars (or cents) per kilowatt-hour. This fact is the basis for the second and third methods. The total number of dollars per kilowatt, that is, the price per kilowatt (not the kilowatt charge) for a certain customer is represented by the tangent of the angle σ, Fig. 3, included between the bottom plane and a plane $OC'ST$ passing through the kilowatt-hour axis OC' and the point p, which represents that particular customer's bill; the average price per

EXAMPLES OF RATES UNDER DIFFERENT METHODS OF CHARGING

Hours' Use per Month	Specific Demand Charge (y) in Dollars per Kilowatt per Month	Dollars per Kilowatt	Cents per Kilowatt-hour
0–5	0.40	0.50	10.00
5–10	0.80	1.00	10.00
10–15	1.20	1.50	10.00
15–20	1.60	2.00	10.00
20–25	2.00	2.50	10.00
25–30	2.40	3.00	10.00
30–35	2.71	3.41	9.85
35–40	2.97	3.77	9.43
40–45	3.19	4.09	9.09
45–50	3.37	4.37	8.74
50–55	3.52	4.62	8.41
55–60	3.64	4.84	8.07
.....	.....	.....	.....
95–100	4.16	6.16	6.16
.....	.....	.....	.....
145–150	4.35	7.35	4.90
etc.	etc.	etc.	etc.

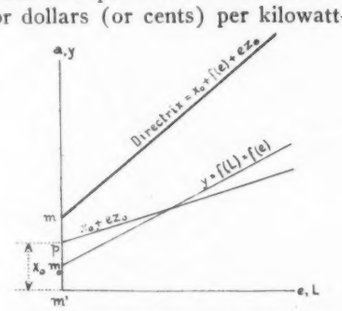


FIG. 7a—STRAIGHT-LINE DIRECTRIX

kilowatt-hour is represented similarly by the angle σ. It is evident from this that if the customer charge $x = OA$ is zero or if only that part of the bill is considered which is formed by the two other charges, then all customers with the same load-factor will have to pay under a rate like Fig. 3 or Fig. 6 the same average price per kilowatt as well as the same average price per kilowatt as well as the same

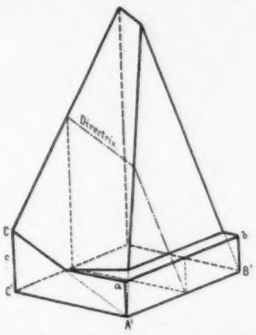


FIG. 8—SOLID REPRESENTING CUSTOMER CHARGE

average price per kilowatt-hour, no matter whether they are large or small consumers. The second and third methods can then be expressed as follows:

Second Method.—The customer will be charged 50 cents per month plus the amounts given in the third column of the table for each kilowatt of maximum demand. Each value in that column has been found from the preceding column by adding the number of kilowatt-hours per kilowatt at 2 cents each (or hours used at 2 cents each) to the corresponding figure of the second column; for instance, in the range forty-five to fifty hours the figure \$4.37 is the sum of \$3.37 + \$0.02 × 50. This type of schedule, with a few minor variations and different figures, is used, for example, among other schedules at Spokane, Wash.

Third Method.—The customer will be charged 50 cents per month plus the amounts given in the fourth column of the table for each kilowatt-hour consumed. Thus, for instance, if his load exists for from forty-five to fifty hours per month he will be charged 8.74 cents per kw-hr. in addition to the customer charge where 8.74 has been found as the quotient of the corresponding figures in the third and first columns, that is, 437 ÷ 50. This general principle of expressing rates in a schedule for the customer is made use of by the municipal lighting department of Seattle, Wash.

Fourth Method.—The curve given in Fig. 9 is approximated by a series of straight lines BPQ. The curved surface of Fig. 6 then changes into a pyramid as shown in Fig. 8, with its vertex at the same point A, and superposed on the same flat slab, $A'B'C'B_1C_1$, the latter being caused

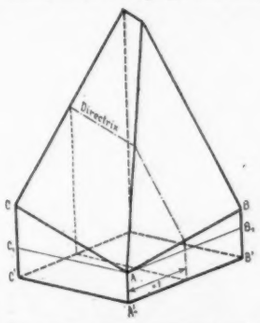


FIG. 8a—SOLID ILLUSTRATING EFFECT OF MINIMUM BILL

by the constant customer charge, which disappears if that charge becomes zero. The shape of this pyramid shows at once that we have arrived at an ordinary multiple-rate system with a given primary charge per kilowatt-hour and a lower secondary charge, the ranges of the two charges being divided from each other by load-factor lines; such multiple rates are shown and explained, for instance, in Fig. 10 of the above-mentioned article in the *Electrical World* of Nov. 4, 1911.

By the term "multiple rate" shall be understood a rate with the following features: The kilowatt-hour consumption is divided into a number of "blocks" progressing either with the number of kilowatt-hours used or with the load-factors (for example, blocks of 100 kw-hr. each, or 5 per cent load-factor each) or by combinations of the two methods. The energy consumption for each block is charged at a certain rate per kilowatt-hour, which decreases by steps from one block to the next. The "primary" rate is charged for the first block, the "secondary" for the second, the "tertiary" for the third, etc. The characteristic of the multiple-rate system is that each one of these rates applies only to its own block and has no influence on what is charged for the other blocks, in counter-distinction to the method in the fourth column of the table, where every reduction in the kilowatt-hour charge applies to *all* kilowatt-hours, beginning with the first one.

This same multiple, or "cumulative block," rate system may also be made to apply to kilowatt charges, and finally both the kilowatt and kilowatt-hour multiple systems may be combined, as, for instance, in the Boston "Schedule C" (see *Electrical World*, Nov. 4, 1911, page 1129), which charges 5 cents per kw-hr. up to 1500 kw-hr. per month, 3 cents for each kilowatt-hour between 1500 kw-hr. and 5500 kw-hr. and 2.5 cents for each kilowatt-hour above

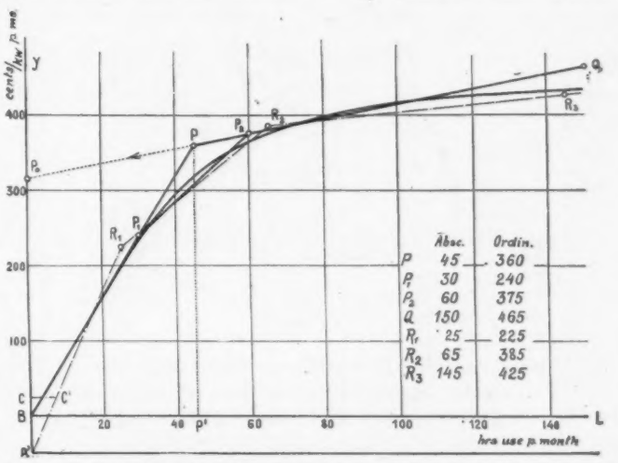


FIG. 9—CURVE SHOWING SPECIFIC DEMAND CHARGE VARYING WITH LOAD-FACTOR

5500, besides the following monthly demand charges: \$5 for each kilowatt below 15 kw, \$3 between 15 kw and 55 kw and \$2.50 above 55 kw.

The primary charge or primary rate applies as long as the corresponding straight line BP in Fig. 9 applies; that is, until the load-factor of forty-five hours per month is reached. After this the secondary rate applies. We can also, with the aid of equation (10), find what the actual figures of the schedule will be if the directrix BPQ is used. It appears from Fig. 9 that up to forty-five hours' use

$$y = \frac{PP'}{BP'} \times L = \frac{360}{45} L = 8L,$$

and for more than forty-five hours' use

$$Y = BP_0 + \left(\frac{465 - 360}{150 - 45}\right) L = 315 + L.$$

Now, assuming again that $x_0 = 50$ cents and $z_0 = 2$ cents per kw-hr., and furthermore that

if $L \leqq 45$ hours	if $L \geqq 45$ hours
$y_0 = 0$	$y_0 = 315$
$k = 8$,	$k = 1$,

equation (10) reduces to

$$a = x_0 + (8 + 2)\, e = x_0 + 10\, e \qquad (10a)$$

or,

$$a = x_0 + 315\, d + 3\, e \text{ resp.} \qquad (10b)$$

The schedule would read, therefore: a constant connection charge of 50 cents per month, and for each kilowatt-hour up to forty-five hours' use, 10 cents per kw-hr.; such kilowatt-hours as are used in excess of forty-five hours' use will be charged at the secondary rate of 3 cents per kw-hr.

According to the rate analysis given in the author's previous article, the equation for this rate for load-factors of more than forty-five hours' use (secondary range) would be:

$$a = x_0 + 10 \times 45\,d + 3\,(e - 45\,d) = x_0 + 315\,d + 3\,e$$

This shows that the demand charge 315 cents per kw of demand in the secondary range checks with the demand charge in equation (10b) as it should do. The customer charge x_0 is of course unchanged and equals 50 cents.

Instead of using but two straight lines BP and PQ to approximate the curve of the demand charge in Fig. 9, the curve can be approximated, of course, by any number of broken straight lines as closely as desired. This will result in tertiary, quaternary, etc., charges. For instance, the directrix BP_1P_2Q would be represented by the following rate: 10 cents per kw-hr. up to thirty hours' use; 6½ cents for all kilowatt-hours between thirty and sixty hours' use

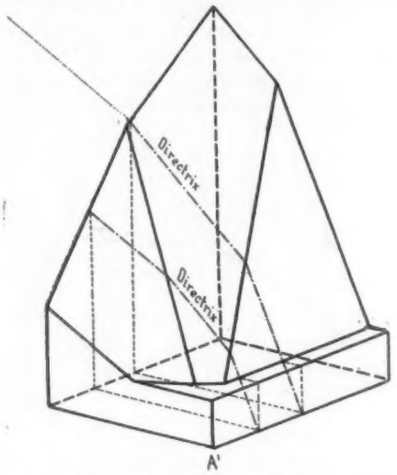


FIG. 10—REPRESENTATION OF MULTIPLE-RATE SYSTEM HAVING PRIMARY, SECONDARY AND TERTIARY CHARGES WITH MINIMUM BILL

per month, and 3 cents for all kilowatt-hours beyond sixty hours' use, besides a customer charge of 50 cents.

III. Substitution of a Minimum Bill for the Customer Charge

In order to simplify the rates, it is often considered desirable to replace the customer charge by a minimum bill. This changes the solid shown in Fig. 8 to the type illustrated in Fig. 8a, and the vertex of the pyramid is lowered by the amount of the customer charge, from A in Fig. 8 to A' in Fig. 8a; and accordingly it is necessary to lower B in Fig. 9 to B'. $B'R_1R_2R_3$ may then be assumed as a fair approximation to the curve, with a minimum, for instance, of 75 cents, thus changing the directrix to $CC'R_1R_2R_3$. This would correspond to a primary rate of $\frac{50 + 225}{25} + 2 = 13$ cents per kw-hr. up to twenty-five hours' use, and $\frac{385 - 225}{65 - 25} + 2 = 6$ cents per kw-hr. for all kilowatt-hours used between twenty-five and sixty-five hours' use, and $\frac{425 - 385}{145 - 65} + 2 = 2\frac{1}{2}$ cents for all kilowatt-hours beyond sixty-five hours' use; minimum charge, 75 cents per month.

Of course, a minimum bill can never replace a customer charge exactly, for although a pyramid with a sufficient number of sides can approximate a given cone with any desired degree of accuracy if the vertices of pyramid and cone coincide, yet it is absolutely impossible to make them exact substitutes for each other if the vertices do not coincide. The best plan, therefore, if it is decided to use a minimum bill instead of a customer charge, would be to choose the position of the directrix mn not at unity distance from the origin, as in Fig. 6, but at a distance repre-

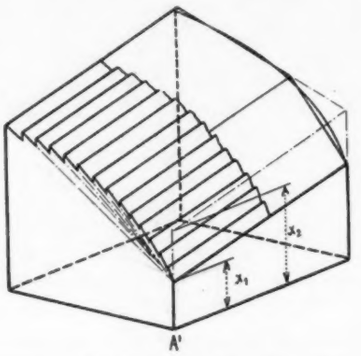


FIG. 11—CURVED SURFACE PRODUCED BY INTRODUCING DECREASING RATES WITH INCREASING ENERGY CONSUMPTION

senting that demand d_m for which a maximum revenue is obtained (which in residence service is about 0.75 kw of maximum demand). Fig. 10 shows a multiple-rate system with primary, secondary and tertiary charges and a minimum bill instead of a customer charge. If compared with Fig. 6 or Fig. 8, it shows at a glance the difference produced by the substitution of the minimum charge.

IV. Interchangeability of the Three Fundamental Charges in General

It has been shown in this article how a variation of the demand charge in terms of the load-factor can be expressed, under certain assumptions, by changing both demand and energy charges from their respective original values. Thus a demand charge proportionate to the load-factor can be expressed by placing the demand charge equal to zero and increasing the energy charge to a constant amount above its true value. In other cases the demand charge may be reduced, without reaching zero, and the energy charge correspondingly increased. The energy charge, therefore, under certain conditions, can take the place either of the whole demand charge or at least some part of it, according to circumstances. A similar inter-

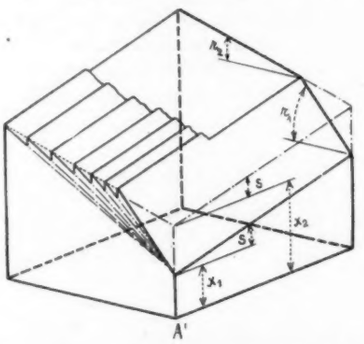


FIG. 12—SOLID SHOWING EFFECT OF REDUCING SPECIFIC ENERGY CHARGE BELOW TRUE VALUE AND INCREASING CUSTOMER CHARGE

changeability between all three fundamental charges may occur in other instances. We might assume, for example, on the value-of-service principle, that large energy users ought to receive smaller specific energy charges in such a way that those charges are gradually lessened as the consumption of energy increases. Then by lines of reasoning analogous to the case treated above in Figs. 4, 5 and 6, it

is evident that the plane shown in Fig. 3, which holds only for constant charges, is changed into a curved cylindrical surface as indicated in Fig. 11.

Without going into details it may be pointed out here that under certain conditions, viz., if z varies inversely with the energy consumption, this cylinder changes back into a plane as illustrated in Fig. 12, where the specific energy

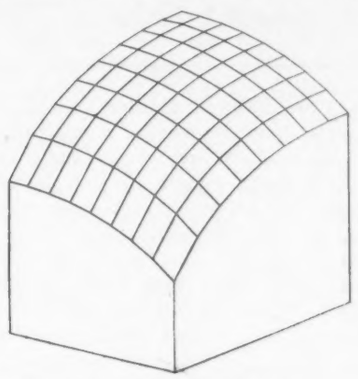


FIG. 13—NUMEROUS PLANES APPROXIMATING A CURVED SURFACE

charge is reduced below its true value and the customer charge increased, while the specific demand charge is unchanged. In this case each succeeding plane, passing toward larger consumption, has a smaller specific energy charge and implies a larger customer charge than its predecessor. In this case the customer charge takes, as it were, the place of the energy charge. The same applies finally to the demand charges, since they also may be decreased for large customers, under the value-of-service theory.

These principles of reducing certain specific charges for consumers having large demands or long hours of use may also be combined with each other, as in the Boston "Schedule C," for example, previously mentioned.

It appears, then, that the specific demand charge may decrease with increasing demands and the specific energy charge may decrease with increasing energy consumption, whereas the customer charge increases with both increasing demand and energy consumption. Another method to the same end, at least as far as the energy consumption is concerned, has been chosen in Portland, Ore., where the light-

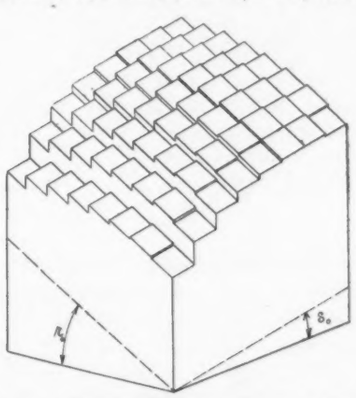


FIG. 14—SOLID REPRESENTING TYPE OF RATE IN WHICH SPECIFIC DEMAND AND ENERGY CHARGES ARE BOTH CONSTANT

ing schedule is a multiple-rate system with primary, secondary and tertiary ranges divided from each other by steps in the load-factor. For that part of the energy consumption which reaches beyond 1000 kw-hr. a discount is made of 1 cent per kw-hr. and for all energy consumed beyond 3000 kw-hr. another cent is discounted. This also raises the customer charges while reducing the kilowatt-hour charges by revolving the planes around the 1000-kw-hr. and 3000-kw-hr. lines into positions which are more nearly horizontal.

If one or more of the three specific charges are changed without any simultaneous opposite change in one of the other specific charges, it can be easily seen from the solid models that this will always cause the surface to become discontinuous, as shown for instance in Fig. 4 or Fig. 5, or in the table. In such cases there are certain customers who, by very slight changes in demand or consumption, will experience sudden or abrupt changes in their bills, caused by passing over discontinuities of the surface, as for instance near AM_1M_2 in Fig. 4.

Fig. 13 illustrates the fact that by means of a rate system which is represented by a series of small planes a close approximation can be had to a curved surface, and as the planes become smaller the approximation becomes closer, approaching the curved surface as a limit. Fig. 14 shows the same type of rate where the specific demand and energy charges are both constant, and only the customer charge is subject to variation; this model exhibits a surface which approaches the surface in Fig. 13 as the steps become smaller.

Fig. 15 shows the same surface composed of differential particles of such planes as have a common constant customer charge $x_0 = OA$ and also a constant specific-demand

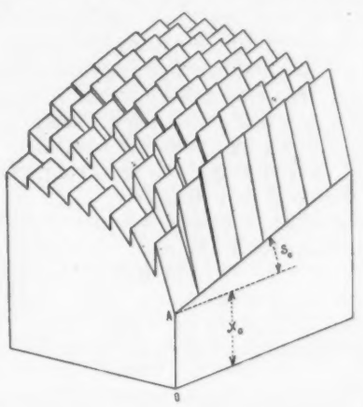


FIG. 15—SURFACE COMPOSED OF DIFFERENTIAL PARTS OF PLANES HAVING CONSTANT CUSTOMER CHARGE AND CONSTANT SPECIFIC DEMAND CHARGE

charge $y_0 = \tan s_0$, whereas the specific-energy charge z is varying to suit the conditions of the rate. The same principle is also expressed for instance in the fourth column of the table, with the exception that the steps are not infinitesimally small there.

Thus the same curved surface can be expressed in general in an infinite variety of other combinations of constant and variable specific charges.

Financial Statistics of Cities

The Department of Commerce and Labor, Bureau of the Census, has published a special report entitled "Financial Statistics of Cities Having a Population of Over 30,000, 1909," prepared under the supervision of Mr. Le Grand Powers, chief statistician for finance and municipal statistics. These tables show in detail the financial transactions of the municipal governments, their indebtedness and assets and the assessed valuation of taxed property. The statistics are analyzed and so presented as to show the net costs of conducting the city's business, together with the net revenue collected and the indebtedness incurred for meeting these costs. In Table 33, which analyzes the receipts from public-service corporations in 1909, a total revenue of $22,957,364 is shown for taxes, licenses, major privileges and charges.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Bright Lining of the Flood Cloud

In some of the cities of the Middle West lately afflicted by floods the central stations have been able to find consolation for their losses in the gains that have been made in other directions. With scores of houses and stores yet uninhabitable the Dayton Light & Power Company is carrying more than its normal load. This is due to two main causes, the first of which is that the company has taken on the load carried before the flood by the independent plants of a department store, an office building and the largest laundry in the city, and has installed many small motors—amounting to at least 1000 hp in all—for work formerly done by gas and steam engines. Every motor the company had or could obtain from outside the city was put to work in short order to take the place of units disabled by the flood. The second factor in raising the Dayton company's load is the increased and new lighting installations in houses and stores that are being rehabilitated. Stores that might have got along for years with twenty lamps in their windows and shops have increased the number as an incident to the general overhauling. House wiring has been easier to get since the flood than formerly.

The attitude of the company was not that of forcing its service upon those sorely in need; it simply asked, "Can we do anything for you?" The intangible benefit from the flood has been the demonstration of the enterprise of the central station, its powers of quick recuperation, and in general the showing that the central station is a good thing to tie up to.

This was shown in many ways, and incidentally the adaptability of electricity for all kinds of work was made plain to power users and the public at large. While the disconsolate shop owner whose basement was full of water was wondering how he was going to get rid of his own particular share of the flood the company's men would set up a small motor-driven pump on the sidewalk, connect up the suction hose and have the cellar free of water in short order and free of charge. Dayton's finest newspaper plant was put out of business by water in the boiler and press rooms. As it would have taken too long to set up the emergency press in the *News* building, the press was placed on the street, where it still stands, its motor connected up to the company's mains, and a board fence built around it. A big sign of the Dayton Light & Power Company on this fence is a constant reminder to the passer-by that it was central-station power that made it possible for the newspaper to run off its editions in spite of the flood.

In any number of cases central-station service was the savior of situations that appeared hopeless to the operators of small plants, with gas or other engines below the street level. One of these was a coffee mill where the machines were driven by gas engines. The mill was one of the concerns to which the company put the query whether it could do anything to help out. The answer was the rather despairing one that the only thing that would help would be to get the machines working. When told that this could be easily accomplished the mill people wanted to know when, and they were incredulous when the reply came, "This afternoon." With the co-operation of manufacturers' salesmen, who were also early at work, one 50-hp motor was installed in a few hours, and the other 100 hp needed was ready the next day.

In Columbus the Railway & Light Company had its system in operation long before the municipal plant was in service. The company, in fact, carried the municipal plant's commercial load for a month, lighted the city hall, and offered to light the streets, but for some reason the offer was declined, and in consequence the larger part of the city remained in darkness much longer than was necessary. Several good motor users that formerly operated independent plants have become customers of the company since the flood, and its load is now better than normal. The quick restoration of the Columbus company's service was due to the prompt and effective means taken to dry out its machines, which with one exception had been 6 ft. under water. These were boarded up, and the inclosures were connected with flues from a number of large heaters. In this way all were ready for operation in less than a week.

Transmission Lines Along Country Roads

A peculiar case of alleged negligence came before the Supreme Court of Washington recently. The defendant, the Yakima Power Company, operates a high-tension transmission line running along a public highway in the Yakima Valley, the wires being supported by ordinary wooden poles at about 40 ft. above the ground. The plaintiff, a farm hand, was riding in a loop of wire cable that hung from the 18-ft. boom of a 45-ft. portable derrick used in hay stacking. While passing along the road, this boom swung to one side and allowed the wire cable to make contact with the bare wires of the transmission line and a circuit to the ground was completed through the person of the plaintiff, resulting in shock and burns. Action for damages was lost in the Superior Court and, in supporting its opinion, the Supreme Court held that a company owning a high-tension line is bound to put its wires high enough to leave the road safe, not for any and all travel, but for usual and ordinary travel. There was no worthy evidence tending to prove that at the time the defendant company erected its transmission line hay derricks 45 ft. high, including the projection of the arm above the mast, were so generally hauled over the road as to constitute ordinary and usual travel.

Securing Small Motor-Load Customers in Duluth

Mr. C. E. Van Bergen, general manager of the Duluth Edison Electric Company, prepared a short but interesting paper entitled "Securing Small Power Customers," which was read by Mr. George W. Gibeau of the same company at the recent St. Paul convention of the Minnesota Electrical Association. Mr. Van Bergen said:

"Duluth is not a manufacturing center, and the motor load obtained has been secured only by hard work and being continually on the job. We work in conjunction with the different commercial clubs of the city and endeavor to encourage in every way possible this class of service.

"Our business is confined to supplying motors of 50 hp and smaller ones according to our contract with the Great Northern Power Company. However, we have now installed about 4600 hp of motors distributed among 671 customers, an increase of 40 per cent in three years.

"Prospective customers for small motors usually make themselves known by inquiries regarding the voltage, cycle and phase of the service supplied. Some inquire first as to rates. As soon as an inquiry is received, a representative calls on the prospective customer, getting details as to the size of motor desired, informing him what firms are agents for motors, and in general getting acquainted.

"If the 'prospect' is already a lighting customer, we point out our policy of allowing the lighting and power loads to be placed on the same meter at the minimum power rate, 6 cents per kw-hr. If he is not a lighting customer, this point appeals to him and thus aids in securing his contract for both services. A minimum charge of 80 cents net per hp per month is made in connection with this 6-cent rate. The class of business usually secured by this method includes grocery stores, meat markets, dentists and others. In the case of a customer who wishes to add to his equipment, we gladly make any tests he desires in order to determine the energy consumed by any or all of his machines.

"We believe in the value of newspaper advertising and run an advertisement at least twice a month in the principal newspapers of the city, making the motor business the feature. We also encourage the small motor customer by either renting him a motor for a few months in order to enable him to make a start in business or selling him one on monthly instalments, the company retaining the ownership of the motor until it is fully paid for. This method gains for us on an average several customers each month. We also take back from customers who wish to increase their motor capacity their old motors and furnish them with larger motors at as near cost price as possible.

"We find it good policy to call on our small motor customers at times and perhaps make suggestions as to rearrangement of shafting or motors or learn if they have any electrical trouble needing attention. These visits are surely appreciated by customers, often leading to increased load. Indirectly they are also of benefit since a satisfied customer is always ready to 'boost' for the concern which shows itself interested in his welfare."

Sales Organization of the Commercial Department

By HARVEY B. MANN

Viewing broadly the sale of central-station industrial-motor service, one cannot fail to note how highly developed it has become in some cities for so new a business, nor how in certain respects it might be improved in other places. The rapid development of such a large selling field has resulted in building up sales organizations from the best material at hand and has precluded, in a considerable measure, the attainment of well-rounded, cohesive organizations and policies such as mark our older industries. While a great deal of real sales work has been done it is apparent that considerable of this business has simply come itself, following a wider general knowledge of electrical power possibilities. In other words, this has been non-competitive business which required little more than exploitation and advertising. Under these conditions high efficiency in motor-service selling was not required and hence not often developed.

The business now enters another phase where its further increase meets competition from isolated plants, installed or projected. To get the central station's share of this business the art of selling service will have to be further developed, and it is the object of this article to outline briefly some features which to a competitor appear worthy of attention.

Foremost among these is that of pure salesmanship. That a higher standard of salesmanship is not apparent in many central-station organizations is probably due to the fact that men have been selected too much on the basis of their electrical-engineering knowledge. While desirable that central-station salesmen have technical educations and necessary that they have engineering experience, these qualifications are of no value unless the men are, fundamentally, salesmen.

Good salesmanship will be of special value in overcoming the popular prejudice against the central station. It is not necessary to prove that this prejudice exists or that it has been justified in many instances by the conduct of the utilities corporation. The psychological basis for such a feeling against the large corporation, and especially the monopoly, is well understood. The enlightened policies of many public-service corporations are doing much to allay this feeling, but it is bound to exist to some extent and is therefore a handicap in selling service which calls for salesmanship.

A vital point in commercial work, and probably the key to the entire situation, is the management of the business department. This position should not be filled by a first-class engineer but by a sales manager. He should have a wide experience in factory power plants, especially steam stations. He should be an experienced salesman and, of course, have the necessary grasp, broadness and executive ability.

Having found no place for the purely electrical engineer in the position of manager or solicitor, let us place him where he will be of most service—in the office as engineer to the power sales department. Any large city office of the electrical manufacturing companies serves as an example of this plan of organization. In one of them we find a sales manager, a motor salesman, a lamp salesman, a mining-machinery salesman, a turbine and condenser salesman and a district engineer. The salesmen's engineering problems are handled by this engineer. The latter holds his position by virtue of his technical ability and is not expected to sell.

Following this plan for the motor sales department, we would have salesmen who sell, a sales manager who directs and assists salesmen and a power engineer who estimates, tests and advises. This type of organization has already justified itself in several instances where it has been only partly perfected.

The power engineer should be competent in both steam and electrical engineering. Practical experience in steam work, preferably in selling steam equipment, is very desirable. This training in steam apparatus sales is suggested because it implies a practical knowledge of the various lines and types of equipment in isolated plants. In the selling end, again, the technical graduate will in a shorter time gain a broader experience based upon many different industries than he will in the engineering office of the same concern. The inside man devotes more of his time to the problems of his own line and has less time to travel and observe general plant equipment than has the salesman. Motor-service engineers can be had with this training, for there are plenty of men now selling who are better fitted to do engineering.

If such training is of value for the motor-service engineer, it is doubly so for the motor-service salesman. Men so trained could come very near telling the chances for getting a job after an inspection of the equipment and an hour's talk with the chief engineer. Unnecessary tests of plants could be largely eliminated, saving expense and likewise the ridicule attendant upon having put a lot of time on a job which an all-round engineer could tell by inspection offered no possibility of saving by purchase of energy.

With this steam training the central-station engineer or salesman could successfully meet the steam-equipment man on isolated-plant propositions. To prove that this knowledge is necessary it may be well to examine a field where competition is of the keenest—that is, where exhaust steam from the isolated plant can be used for heating or drying.

If the central-station salesman knows what can be done with this steam, how much is required, the cost of the equipment, its efficiency and economy, then, and then only, can he present a good case. The motor-service engineer analyzes the situation and prepares a comparative statement, but cold facts and figures are far from infallible in getting a contract signed. It takes the salesman to put life into it, to drive home the points, and especially to secure weight for such items as "personal attention," "fear of shut-downs," "explosions" and "injury to workmen," which cannot be expressed in black and white. To do this effectively the salesman needs to have steam experience.

One just-out-of-college central-station salesman reported a test of an isolated plant showing an evaporation of 62 lb. of water per lb. of coal. Failure to know at sight that such a result was wrong showed a lack of practical knowledge quite too general. Slips like that cause other statements of the central-station's men to be discounted, and such blunders are used to the full by the competent and experienced steam men who are boosting the isolated plant. While this is an exaggerated example, it serves to emphasize the necessity of having in the motor-sales department men who are not lost the moment they get beyond the magnetic field of their textbooks.

It is very essential that comparisons made by the motor-sales department between central-station service and the isolated plant be on a conservative basis. The major portion of such a comparison is in working up the costs of the isolated plant, and this cannot be done properly without a practical knowledge of such plants. It is advisable that such a report show somewhat better economy than can actually be maintained. Give one's competitor the benefit of the doubt and it helps one's cause, provided the customer is shown how liberally the costs have been figured. Underestimate a competitor's position and the observant customer discounts one's statements in a greater proportion.

A thorough knowledge of isolated plants, aside from its value in making reports, is also desirable in discussing the proposition with owners or engineers. The motor salesman's competitor is the customer himself who proposes to make for his own use that which the central-station wishes to sell him. That competing isolated plant must be argued against, analyzed, pulled apart and every element properly tagged. Such analysis must be done fairly, cleverly, tactfully and without "knocking." Of course, no salesman can expect to do this without thoroughly knowing his subject. He must know the cost of fuel available and its heat value, the cost of water and its quality, the probable efficiency of the boilers and engines to be used, and more especially the heating requirements.

An organization of salesmen, engineers and sales manager selected as above suggested would go far toward improving the situation and decreasing idle investments in plant and equipment.

Extension of Central-Station Service in St. Louis

About thirty isolated plants in St. Louis, supplying electricity and heat to buildings ranging in size from 1,000,000 cu. ft. to 8,000,000 cu. ft., have been displaced by the service of the Union Electric Light & Power Company during the last year. In several cases the contract for supplying electricity from the central station is accompanied by the agreement to furnish the entire engineering service required in the building. The operation of the generating units has been discontinued in each case, and the boilers are used only for supplying heat to the building in which they are located and to some others in its locality. Where the boilers cannot pass an inspection for high-pressure steam they are utilized by connecting them to a low-pressure heating system. As many as ten buildings are heated from some of the steam installations. Some of the buildings require steam for seven months during the year. One economy effected by central-station service is the operation of several heating installations by one fireman. Two foremen are employed to supervise the buildings. The main inducements offered to the owners of private plants are the elimination of heat in the summer, freedom from supporting an engineering corps and reliability of service.

Public Service Company's Booklet on Refrigeration

Encouraging reports from central-station companies that have a refrigerating auxiliary have been referred to in these columns. The Public Service Electric Company, of Newark, N. J., is sending out a booklet entitled "Mechanical Refrigeration: Saves Half the Cost of Ice" which tells the story for the benefit of the prospective user of refrigeration. It illustrates a number of installations and gives practical data, comparing previous cost when ice was used and present cost with mechanical refrigeration, which in some cases show a decrease of 50 per cent in the ice bills. In terse sentences the booklet tells the reason why mechanical refrigeration is superior to the old method of cooling with ice. Written for the ultimate consumer, the booklet with its neatly printed pages and good make-up serves its purpose well and illustrates the progressive spirit shown by the company.

The Power That Rocks the Cradle

Demonstrating that central-station service can easily play the part of nursemaid while assuming the varied rôles of servant in the house, the Marion (Ind.) Light & Heating Company has been featuring a window display of household devices in which a washing-machine motor is adapted to the unusual additional purpose of rocking the baby to sleep. As shown in the illustration, the scene depicts the housewife complacently reading, while about her in automatic operation are to be seen an electrically driven sewing machine, washer, wringer, flatiron, etc. At the front, attached to the washing-machine outfit, is a wheel and crank which gently oscillates the child's carriage, occupied by a big doll. This newest household application of electricity, which originated in Marion, contributes to the force of the local booster campaign to "make Marion move!" The manager of the new-business department is Mr. H. E. Gant.

CENTRAL-STATION WINDOW DISPLAY IN MARION, IND.

Electric-Heating Plans at Marblehead, Mass.

At a recent hearing given by the Massachusetts Gas and Electric Light Commission upon a petition of the Marblehead municipal electric light plant for authority to sell electricity at less than cost as defined by Section 22, Chapter 34, Revised Laws, a discussion of unusual interest was presented by the petitioner on the relation of prospective electric-heating service to the existing average cost of production and to the coming summer campaign for new business on Marblehead Neck, a famous residential resort on the North Shore. The town desires to sell electricity for heating purposes at 5 cents per kw-hr., a price admittedly below the present average cost, but justifiable, it is contended, on commercial and engineering grounds.

The plans of the municipal light board were outlined by its consulting engineer, Mr. C. W. Whiting, who stated that for the year ended June 30, 1912, the average cost of all electricity sold, computed by the statute law above mentioned, was 6.66 cents per kw-hr. The station equipment consisted of two 200-kw and two 100-kw units, or a total of 600 kw, and the expenses upon which the above unit cost was figured were: Operating expenses, $30,667; interest charges, $3,180; sinking-fund requirements, $1,000; depreciation, at 5 per cent on the cost of the plant, $9,214; total, $44,061. The plant sold during the year 661,056 kw-hr.

The municipality advanced the opinion that there may be two good reasons for selling this electricity below the average cost. First, if the price were greater than the actual cost of the specific service under consideration, there would be a profit from that service and it would be advisable to establish it. Second, even though the price were less than the cost computed as above, it might be a remunerative price because of some other reason.

It was shown that if the Marblehead plant had been built purely for electric heating service, its cost of construction would have been less by about $18,052, giving a revised cost of plant of $166,231 and a lower depreciation charge of $8,312. The expenses of operation would have been less by $3,939, since the cost of operating the lighting distributing system would have been omitted. The total yearly expense, estimated on the basis that the plant was built solely for electric heating, was $39,220. This gave a unit cost of 5.93 cents per kw-hr. sold on the foregoing output, which was set forth by the town's engineer as the highest estimate which could reasonably be considered.

The accompanying load curves were presented showing the output of the plant at certain hours on a typical summer day when the maximum peak of the year was handled and on a winter day, when the output was greatly reduced. It was pointed out that with one of the larger units held in reserve as a spare machine the remaining units have a capacity of 400 kw, which is sufficient to handle the peak

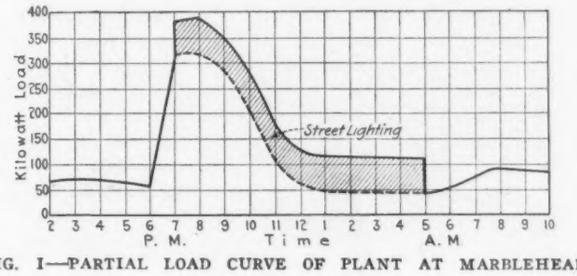


FIG. 1—PARTIAL LOAD CURVE OF PLANT AT MARBLEHEAD, MASS., AUG. 19, 1912

load. This normal capacity of 4000 kw would generate 3,500,000 kw-hr. per year, and yet during the fiscal year taken only 822,692 kw-hr. was generated. The station, the distributing system and many of the expense items have a reserve off-peak capacity figured at 2,677,000 kw-hr., and the managers of the plant contend that a heating load will help in this direction. Electricity used in the warming of the rooms would not be called for during the peak of the load, primarily because the peak occurs during the summer time and secondarily because the peak occurs late in the day when the rooms are already warmed. Electricity for cooking would principally be called for just before meal hours. The first of these two periods would be entirely off the peak and the last would overlap the peak, if at all, by an

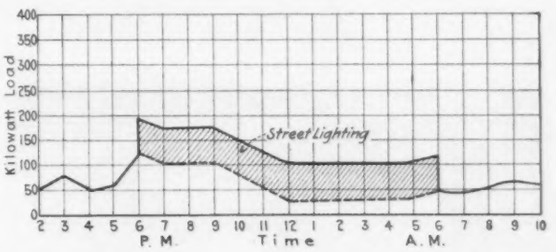


FIG. 2—PARTIAL LOAD CURVE FOR PLANT AT MARBLEHEAD, MASS., FEB. 14, 1913

inappreciable amount. The peak maximum occurs at 8 o'clock. If the additional load due to heating were entirely off the peak, as it is believed it would be, then the additional cost of carrying it would be very low. If the additional load were as much as 10 per cent, the added cost would be almost inappreciable. The coal and water costs might be increased say 8 per cent, but the other costs would not be increased at all.

If such conditions obtained, the actual additional cost would amount to only 1.05 cents per kw-hr. This was the lowest estimate which was considered fair. The end sought is a greater profit to the plant through the building up of an off-peak load. It was testified that if such a load could be built up by the introduction of heating and cooking devices, so that the total energy sold would be double the present output, the only added expense would be for coal, oil, waste and water. If these were thereby increased 80 per cent, 50 per cent and 80 per cent respectively, the cost of all electricity sold, computed as at first, would be 3.87 cents per kw-hr., including all charges as provided by law.

Mr. Robert W. Carey, manager of the plant, testified that a twenty-four-hour service is given and that the town has many summer residents unable to use anything but coal stoves, on account of the absence of gas service along the shore. Conferences with the manufacturers of electric stoves and ranges had brought out the reliability of such equipment, and it is estimated that 1 kw-hr. will cook three meals a day for one person with careful handling of the apparatus. The motor load in the town includes all but five of the industrial concerns within its borders, there being about seventy motor users. At times the "power" rate on the sliding scale goes below 5 cents per kw-hr. A few customers use enough energy to obtain a rate between 3 cents and 4 cents, notably in glue-factory work, where the motors are run continuously night and day in the glue-making season. The latter extends through the fall and winter months, generally from October to May, and at this period the electric-lighting load on the system is lowest on account of the summer lighting business secured from cottages and bungalows. Separate meters are to be installed for cooking. The summer residents number about 400 and are mainly wealthy persons who would use a large amount of electrical energy for cooking and heating if the price were reduced.

Several of the larger customers, including the Eastern Yacht Club, have expressed the desire to adopt electric heating and cooking, using electric radiators to take off the chill of rooms early and late in the season. Mr. Carey stated that the town will require the customer to put in the installation and wire the building and declared that at 5 cents per kw-hr. the plant could compete successfully with water gas for heating water.

Illumination and Wiring

Lighting of a Department Store

The modern department store presents a large variety of conditions to be met by the illuminating engineer. To obtain perfectly satisfactory results it is often necessary to design special equipments of globes and reflectors and much experimental work has been done by designers and manufacturers to meet conditions encountered in such installations.

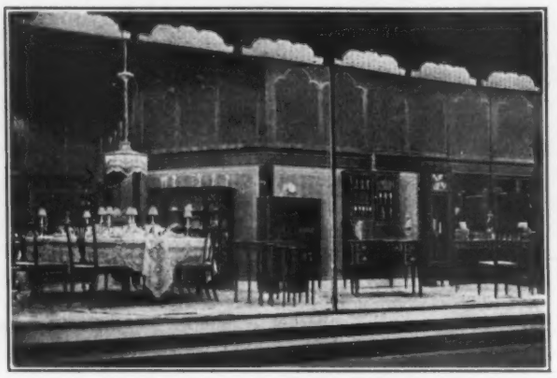


FIG. 1—DISPLAY WINDOW LIGHTED WITH CEILING TROUGHS

The lighting of the Bamberger Store in Newark, N. J., presents some interesting features in the illumination windows, showcases, etc.

The show windows are high and deep and are finished in massive panels of mahogany. For the illumination 25-watt tungsten lamps placed 9 in. apart in Frink trough reflectors are used. The reflector is contained in a ceiling gutter about 8 in. from the plate glass. It is made of metal and lined with rippled mirror glass designed to produce an even distribution of reflected light throughout the area to be illuminated. It was necessary to take into consideration back-reflection, as the high polish of the ceiling and back wall would ordinarily cause spots or high lights; moreover, the source of light had to be concealed so as not to be objectionable to pedestrians looking into the window. For this purpose a shield is inserted down from the inner side of the reflector. The wiring is arranged in alternate circuit so that half of the lamps can be lighted at dusk and the remainder later.

FIG. 2—ILLUMINATION IN HOSIERY SHOWCASE

All showcases in the store are fitted with Frink showcase reflectors placed in the upper front corner and finished in bronze to harmonize with the case fittings, and they vary in length from 4 ft. to 15 ft. The lamps are hidden from view and the reflection obtained is free from streaks. Tungsten lamps of 15 watts and 25 watts are used. In cases where material of dark texture is exhibited use is made of the larger size lamps, while in other cases where lighter material such as laces is shown the smaller size of lamp has been found sufficient. High wall-cases are treated similarly, but wherever possible the reflector has been installed in a false ceiling with provisions similar to those in the windows. Each case is controlled by an individual switch so that the light in any section is entirely independent of that in the others.

FIG. 3—ART-GALLERY ILLUMINATION

The art gallery is illuminated from Frink reflectors supported by wall brackets 12 ft. from the floor. The light is of sufficient intensity to bring out the true color values and is reflected in such manner as to produce the desirable realistic effect. There is a total length of 175 ft. of reflectors.

In the rug department the rugs are suspended from hinged frames. To light these displays semi-circular reflectors measuring about 50 ft. in length were erected just outside the arc described by the swinging frames of the rack. This arrangement permits the whole surface of the rug to be uniformly lighted while being exhibited to customers. Directly under the reflector is placed a shield which cuts off any light which might fall within the range of vision. Fifty-five 16-cp carbon lamps are used in each reflector, this type of lamp having been found most suitable for the purpose. They are wired alternately so that all or half the number may be turned on as the occasion may require.

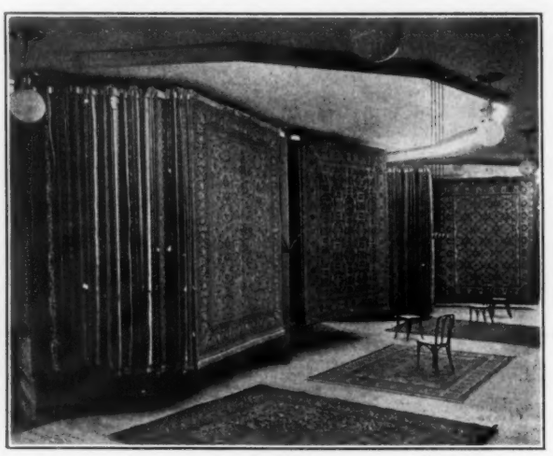


FIG. 4—LIGHTING UNITS IN RUG SALESROOM

The Effects of Radiation on the Eye

At a regular monthly meeting of the New England Section of the Illuminating Engineering Society on April 21 Dr. Louis Bell, of Boston, Mass., outlined the results of recent researches, in collaboration with Dr. Frederick H. Verhoeff, of the Massachusetts Charitable Eye and Ear Infirmary, upon the effects of radiation upon the eye. These researches extended over a year. The object of the investigation was to determine experimentally the effects of radiations from infra-red to ultra-violet upon the various media of the eye, quantitative relations being especially sought. Most of the experimentation was performed upon rabbits. The light sources chiefly used were the quartz-tube mercury-arc lamp of 3.3-amp rating and magnetite-arc lamps of 6-amp and 10-amp rating. An enormous number of observations were made, and many of the data are yet to be worked into shape for publication. Dr. Bell said that as a result of the tests it was made absolutely plain that under ordinary commercial conditions surrounding the use of even the more brilliant illuminating agencies no specific danger exists, and that only by the grossest neglect and deliberate protracted exposure of the eye to brilliant light sources at close range is there the slightest chance of injury to the organs of vision in the practical application of modern illuminants, except in so far as temporary injury may be due to the effects of ordinary visible radiation.

Observations were specially directed to the study of ophthalmia electrica. It was found that the cornea of the eye does not permit the passage of extreme ultra-violet rays, waves of shorter length than about 2950 units being cut off. The absorbed rays attack the cornea, however, and the first effect noticed is a slight stippling, the next stage being a slight haziness which temporarily interferes with vision. The eye of the rabbit has probably somewhat greater recuperative power than has the human organ of vision. In the experiments the steadiness of the quartz-tube mercury-arc lamp was of great value, but where a point source of light was required greater concentration was secured by the use of the magnetite-arc lamp. The researches showed that for wave-lengths below 3000 units about 5000 ergs per second per square centimeter would produce in five minutes a barely perceptible effect on the cornea. The law of inverse squares was verified over a range of intensities of 100 to 1 for distances above 20 cm. The above figures mean that 15×10^8 erg-seconds per square centimeter will produce an effect of stippling on the cornea. This gives a basis for figuring at what distance one can expose himself for a given time to a powerful source of light. The law of inverse squares means that if the effect is secured in five minutes at half a meter, at a distance of 2.5 meters, twenty-five times as long, or more than two hours, would be required to produce the same results. Therefore, under no ordinary circumstances, where any kind of powerful modern light source is treated with any sort of respect, can one injure the cornea. With a diffusing globe the length of exposure for the production of ophthalmia electrica is practically unlimited. Even with lamps which are most powerful in ultra-violet radiation there is no practical chance of damaging the cornea.

The investigators also found that subdividing the exposures of the subject to the light source but applying the illumination at more frequent intervals produced the same effects as the longer exposures farther apart. The subjection of the cornea, however, to repeated exposures seemed to stimulate the natural repair processes, and with the longer intervals between exposures little cumulative effect was observable. With an exposure interval of forty-eight hours two weeks were required to obtain any material effect on the cornea. A subliminal exposure of the amount sufficient to show an effect on the cornea when given daily was found to be overcome by the repair processes when extended to a two-day interval. The eye apparently develops power to resist the stimulus, and this was shown by comparing the two eyes of a rabbit, one of which had not been exposed to the light source, after a series of repeated exposures. The fresh eye did not resist the effect of the light source as well as did the one which had been under test, the latter having apparently acquired a sort of immunity.

Many other experiments were performed by the use of crown and flint glasses, Euphos glass, copper-chloride solution and other special media. Crown glass cut off all the rays that the cornea absorbed, and flint glass cut off everything shorter than a wave-length of 3250 units, stopping every effect. The Euphos glass cut off all waves of shorter length than 3900 units. With flint glass no effect whatever was noted on either iris or cornea, but on very long exposures there were slight changes in the lens capsule produced apparently by heat. When working with the solar spectrum the heating effects gave trouble, and the function of heat in killing bacteria rather than the characteristics of the light itself was indicated by other experiments. Retinal changes were practically nil except when dealing with "eclipse blindness."

Ousting Overhead Pole Lines from Panama

At Colon, in the Canal Zone, the work of removing all poles and overhead wires from the thoroughfares is now in progress. All electric light and telephone wires of the Panama Railroad Company are being placed in vitrified conduits. These conduits contain six ducts with 3.5 in. openings and are being incased in concrete to a thickness of 2 in. Four of the six ducts are designed to contain motor and lighting circuits; one is for the telephone cables, and the sixth is for possible future growth. Manholes of sufficient size to facilitate the drawing in of cables were built of terra-cotta tile, concrete and cement. It was not found possible to keep these manholes free from seepage water from the sea, and hence openings were made in the sides of each manhole at the level of low tide to prevent the water from reaching the cables. Although the cables are waterproofed, it was thought that their contact with salt water and cement might create a local chemical action that would tend to injure them. Smaller ducts are being laid to outlying points for carrying 25-cycle energy to electrically operated sewer pumps and similar apparatus.

Recent Telephone Patents

Circuit System

Mr. C. S. Winston, of Chicago, has invented a circuit system for use in connection with a service meter. His patent is assigned to the Kellogg Switchboard & Supply Company. The meter is arranged for installation at the central office. Its operating winding is connected in series with the cut-off relay. The meter responds only to an excessive current introduced by a special manually operated key which the operator must depress. In some circuit systems of this sort the operator must remember to count the call at the end of each conversation, but in this system the count is registered upon response of the called party. To this end the circuits are so arranged that an auxiliary relay causes the calling cord supervisory lamp to glow as soon as the called party responds. When the counter key is depressed in response to this signal, the supervisory lamps are restored to their usual relation.

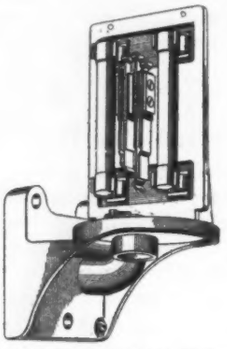
Improved Instruments

An improved receiver of the watchcase type is the subject of a patent granted to Mr. C. Adams-Randall, of Boston. The permanent magnets are semicircular in form.

Two compound magnets are built up of these and are secured at their extremities to flat soft-iron pole pieces. The magnets have all north poles together and form a ring which will slip loosely into the casing. The pole pieces extend slightly beyond the outer edge of the ring and are shaped and threaded to fit internal threads on the casing. The inner ends of the poles upon which the bobbins are mounted are bent up to face a diaphragm. An adjustment of the air-gap is effected by moving the magnetic system forward or back within the shell.

Railway Telephones

For dispatching of trains, especially interurban electric trains, telephone line terminals are frequently arranged along the right-of-way and telephone sets are carried in the cars. As telephone lines under such conditions are exposed to induction from high-tension lines, persons using the instruments frequently receive shocks of more or less severity unless proper protection is afforded. A patent



JACK-BOX FOR RAILWAY TELEPHONES

granted jointly to Mr. A. Dixon, of Newark, N. J., and Mr. W. E. Freeman, of East Orange, N. J., covers a jack-box made for this service. The illustration shows a view of this box with the cover removed. The plug aperture is closed by a trap door and tubular fuses are included in the circuit. On the rear of the vertical plate ground protectors are mounted. This patent is assigned to the Western Electric Company.

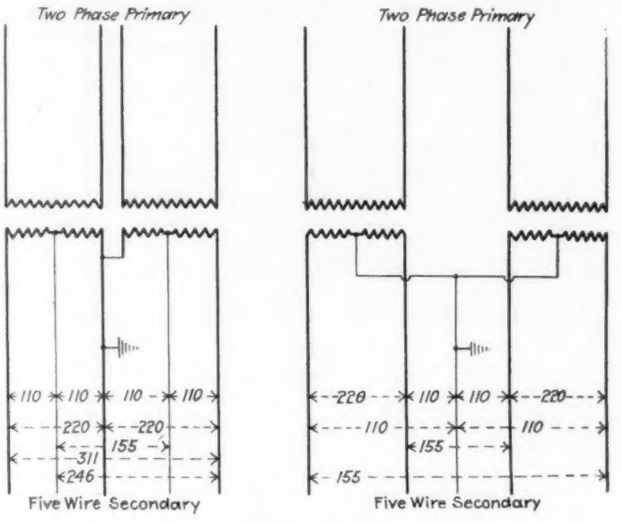
Letters to the Editors

Lamp Operation Due to Accidental Ground

To the Editors of the Electrical World:

Sirs:—The article on "Lamp Operation Due to Accidental Ground" in your issue dated April 5 forcibly illustrates some of the difficulties resulting from improper distributing methods. Referring to Fig. 1 herewith, in connection with the article mentioned, it will be observed that a ground on one wire places the other wires at varying potential to earth, ranging from 110 volts as a minimum to 311 volts as a maximum. The difficulty resides in the "series" connection of the two separate three-wire secondary circuits. It is impracticable to ground such a combined system, not only because the neutral wire of each three-wire system is placed at a potential of 110 volts to earth, but also by reason of the fact that the arrangement is such as to prevent the elimination of the neutral fuse which is essential to the safe operation of a three-wire system. Moreover, the middle wire of the system must carry 42 per cent excess current, and use must be made of neutrals which are larger than necessary because of mechanical reasons.

In Fig. 2 is shown the proper method of operating a five-wire combined lighting and motor-service secondary system. There are practically two separate single-phase circuits which are suitable for motor service at 220 volts. The neutral wire is common to the two single-phase circuits. The arrangement minimizes the copper required and permits proper grounding. The maximum emf between wires is 220 volts, and the maximum to ground is 110 volts. With this connection the trouble mentioned in the article could not have occurred, as each customer is independent of the others in so far as interference from grounds is concerned. A ground on one customer's wiring would either immediately cause his service fuse to blow, if on a phase lead, or it would give an additional protection to the system and his own wiring if on a neutral lead.



FIGS. 1 AND 2—IMPROPER AND PROPER CONNECTIONS

The trouble from meters failing to register when the circuit is grounded is quite common. It is attributable to the careless practice of not testing two-wire circuits to ascertain which is the neutral lead, the chances being that one-half of the series coils of the meters are connected in the neutral lead, where they are liable to become shunted by a ground on the customer's side of the meters. The remedy for this trouble is simply never to connect a two-wire meter with its series coil in the neutral. If the service wires enter a basement through a conduit the making of this test does not involve much additional work to bridge or remove the neutral fuse holder and at the same time connect the neutral wire to the wire used for grounding the service conduit to the water pipe. Such an installation is as near fool-proof as the present state of the art will permit. With it no such complications as those shown in the article can be encountered.

Toronto, Ont. S. Bingham Hood.

Safety in Converter Substations

To the Editors of the Electrical World:

Sirs:—Among the safety measures adopted by the Public Service Commission of the First District of New York, as given on page 975 of your issue dated May 10, is one relating to the safety of attendants in rotary-converter substations, as follows: "There shall be at least two operators on duty in rotary-converter stations delivering energy at 500 volts or higher when the same are in operation." This rule places emphasis on the voltage of the direct-current circuits, while what the operators fear are the high-tension alternating-current supply circuits. The fact is that in many substations where the supply circuits operate at as high as 3000 volts only one operator is on duty. Under such conditions there should be at least two men in each substation, if the service is to be continuous.

Lawrence, Mass. Carl H. Lesure.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Horizontal Tubular-Boiler Setting

A form of horizontal tubular-boiler setting which differs markedly in two of its features from any of the common forms that are used for horizontal tubular boilers is shown in the accompanying engravings taken from the publication of the engineering and inspection division of the Travelers' Insurance Company and the Travelers' Indemnity Company of Hartford, Conn.

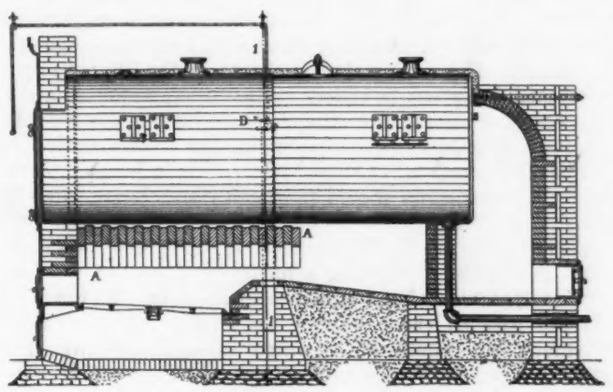


FIG. 1—VERTICAL LONGITUDINAL SECTION THROUGH BOILER SETTING

The two distinctive features are by no means experimental, having been used to a limited extent for a long time and both having been thoroughly tried out in practice. For some reason they have not heretofore appealed very strongly to boiler designers and, therefore, they have not made much of an impression in boiler practice, yet experience has shown that if the settings are properly designed and constructed they effect a great improvement in the combustion of the fuel with a consequent increase in the efficiency of the boiler.

The features referred to are the ignition arch, *AA*, which extends over the entire furnace, and the air duct, *BB*, which permits of the admission of air to the furnace at the bridge wall.

The Furnace Arch

In the type of furnace that is commonly used for a horizontal tubular boiler the shell of the boiler forms a sort of roof over the fuel bed, and as this roof is colder than the fire immediately below it by 2000 deg. or more, it chills the gases that rise up from the fire and checks the combustion that would otherwise go on in the gas spaces of the furnace. The loss that results in this way is sometimes very considerable. By protecting the burning gases from the chilling effect of the relatively cold boiler the furnace arch causes them to retain their heat until the combustion is practically complete. To obtain the best effect the alternate courses of the arch should be set at slightly different heights, as is best shown in Fig. 1, the difference in level being an inch or so. The object of setting the courses at different heights in this way is to make the end surface of the arch uneven so that the furnace gases will be thrown into little whirls or eddies and become thoroughly mixed instead of sweeping along in a uniform undisturbed current as they would be likely to do if the surface of the arch were smooth and even. Furthermore, the projecting corners being exposed to the fire more intimately than they would be if the arch were smooth become very highly heated so that they tend to ignite any unburned gases that strike against them.

Another advantage of the furnace arch is that it affords a much needed protection to the boiler itself. Nearly all of the burned and cracked plate, bulges and girth-joint troubles that are met with in horizontal tubular boilers occur either directly over the furnace or close to the bridge wall. The heat to which the lower part of the shell is exposed, over the furnace, in the usual form of setting is so intense that a slight deposit of scale upon the sheet or a slight coating of oil is often sufficient to lead to very serious damage to the boiler. The furnace arch, protecting this part of the boiler from the direct action of the fire, minimizes the action and does away with nearly all of these deflects and thus greatly prolongs the life of the boiler.

The cost of a bulge or crack or other defect upon the fire sheet of the boiler is by no means fairly represented by the boiler-maker's bill; for putting a boiler out of service for repairs, particularly in a small plant where there are only a few boilers, often means serious loss of production while the repairs are being made, and the furnace arch, by preventing losses of this kind, increases the efficiency of the plant as a whole by an amount which may be large and very real, although not capable of being stated definitely in figures. It should be noted, too, that the furnace arch itself does not add to the number of things that may require the plant to close down or to curtail its production, because the boiler could still be operated with fairly good economy even if part of the furnace arch should fall, and the arch could be repaired later when convenience would permit.

The arch, as will be seen, spans the furnace from side to side and extends toward the rear to a point just back of the bridge wall. There is doubt in the minds of many who have not had experience with furnaces of this kind if an arch of this nature can be made durable when exposed to

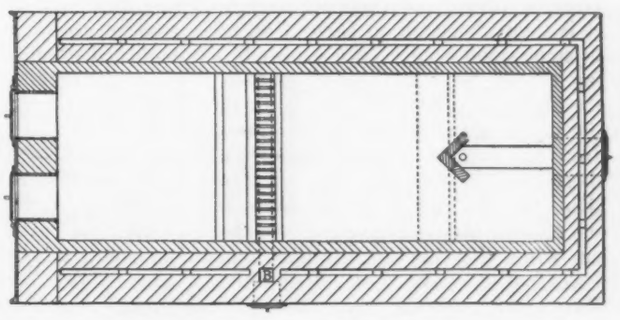


FIG. 2—HORIZONTAL SECTION THROUGH BOILER SETTING

such a fierce heat from below. There is no trouble in maintaining it, if it be built properly in the first place, but it should not be installed in an inferior manner nor with inferior material. It should be built of specially shaped firebricks made with a taper adapted to the exact shape that the arch is to have and laid with a thin mixture of fireclay and water. The firebrick buttresses against which

the ends of the arch rest should also be adapted to their own special duty, and buckstays or other devices should be provided if they appear to be necessary to sustain the horizontal end-thrust of the arch. If these things all receive proper attention, the arch should be quite durable, because in its regular service it has no weight to sustain except its own, but if the man who puts in the setting tries to build the arch of ordinary firebrick trimmed by hand to a guesswork taper, or if he uses a proper brick that is made with a wrong taper, then the arch is quite likely to give trouble. This, however, is no fault of the designer.

It is hardly necessary to point out that the boiler should be set higher than usual when a furnace arch is to be used, so that there may be plenty of space under the arch for the fire and for the operations that are necessary in maintaining and cleaning it. The only objections that are used against the use of the furnace arch are (1) that it is hard to maintain such an arch in position over the fire, (2) that the arch interferes with the inspection of the shell plates of the boiler, and (3) that more or less of the heating surface of the boiler is sacrificed by the introduction of the arch. None of these objections is serious, however.

Auxiliary Air Supply

There are times in running a boiler under natural draft when the air that passes up through the fire is not sufficient to insure the complete combustion of the fuel, and it is then important to furnish an additional supply of air in some other way. This is usually accomplished by opening the registers in the fire doors and perhaps "cracking" the doors themselves. The cold air that then enters through the doors does not all mingle immediately with the gases from the fuel, but a considerable part of its rises up over these gases and forms a sort of screen or blanket between them and the boiler. If the doors be opened only a trifle, the cold air may not have any serious effect upon the boiler; but when they are opened wide enough to admit a large excess of air, and there is no furnace arch present, the boiler plates are likely to become chilled and to develop cracks or defects of other kinds. This action is practically eliminated when the furnace arch is used, because the entering air cannot strike the boiler plate without first traversing the entire length of the furnace and becoming well heated; but even in this case it is better to admit the supplementary air at a point further back in the setting, rather than to allow it to enter through the fire doors. In fact, experience indicates that it is best to introduce it at the bridge wall.

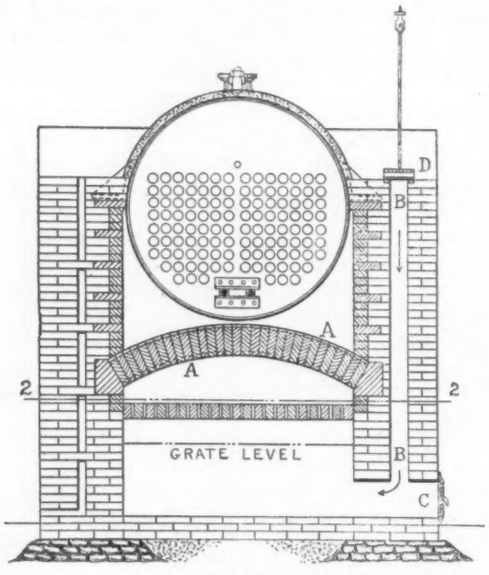


FIG. 3—SECTION THROUGH IGNITION ARCH

The bridge wall is hollow in the setting here shown, a chamber 6 in. wide running through it from one side of the furnace to the other. This chamber is covered by a layer of firebricks that are set on edge and separated from one another by free intervals of about ¼ in. A duct leads to the interior of the bridge wall from the outer air, the draft through it being regulated by a butterfly valve, *D*, that is controlled by a cord or chain or other convenient means. When it is desired to introduce more air into the furnace—as, for example, after firing with fresh coal—the butterfly valve is raised by means of the controlling cord. Air then enters the duct, flows into the chamber in the bridge wall, streams upward through the narrow spaces between the bricks at the top, mingles with the gases coming from the fire and provides the oxygen that is needed for completing the combustion of these gases. The air has become warmed to a considerable extent by the time it leaves the bridge wall, and it is correspondingly more effective than it would be if it mingled with the gases while at the temperature of the boiler room.

As indicated at *C*, a suitable cleaning door is provided for removing the fine dust that accumulates in the bridge wall chamber. The setting that is shown in the illustrations is designed for a single boiler. When several boilers are to be set in a battery the design should be slightly modified in several respects, but the changes that will be needed are rather obvious.

Boiler attendants should thoroughly understand that the loss that results from incomplete combustion, due to a deficiency of air in the furnace, is far greater than the loss that is due to heating a moderate excess of air from the temperature of the boiler room up to that of the gases in the base of the chimney. In ideal firing the supplementary air would be admitted in precisely the right amount; but as ideal conditions cannot always be realized, the fireman, when in doubt, should err on the side of admitting too much rather than too little.

Re-establishing Service After Flood

The recent floods which wrought such havoc in the Middle States and also did considerable damage along the Atlantic seaboard will long be remembered by the electrical fraternity. One of the companies in the East which passed through a trying experience was the Adirondack Electric Power Corporation, which has two hydraulic plants on the upper Hudson River above Albany and Troy, N. Y. As a result of the flood the Spier Falls station was covered with water to a depth of about 3 ft., or practically up to the shaft of the generators. The flooring over the wheel pit, being of wood, floated around the station, and when the water receded debris of all kinds was found to have accumulated. Many of the transformers in that plant are of the air-cooled type and the water entered the air ducts and flooded the transformers and the blower motors, putting them out of commission.

As soon as the power house became accessible the generators, which are wound for 2300 volts, were first turned over for about twenty-four hours without excitation, thus throwing the water out of the rotors by centrifugal force and starting the air circulating around the field structures. An exciter unit was brought by automobile from the works of the General Electric Company at Schenectady, and for three days the generators were run short-circuited upon themselves with low excitation. The air-cooled transformers were wound for 30,000 volts and, although a constant blast of hot air was passed through them and the coils heated by electricity in addition, they still "dripped" after two weeks of such treatment.

At the Mechanicsville plant of the company, lower down the Hudson, greater damage was done. The operating

head at that point is 18 ft., and the water backed up in the station to a maximum height over the floor in the generator room of 9 ft. As the water receded everything was found to be covered with a thick greasy mixture of oil and mud. It was practically a week before the generator room floor was free from water. The machines, which were wound for 12,000 volts, were put under load after being dried out and cleaned with much misgiving.

Output of Ice-Cream Plant to Be Increased with Same Electrical Equipment

By altering the system of freezing used in the ice-cream plant of the Banner Creamery Company, of St. Louis, Mo., Mr. G. A. Bang, president of the company, hopes to obtain a considerable increase in the output with the same electrical equipment. About 140,000 gal. of ice-cream was manufactured in 1912, and he expects to realize an output of 200,000 gal. in 1913 with the new freezing equipment. Numerous experiments were conducted by him last year in which attempts were made to discover more efficient methods of freezing ice-cream. As the air surrounding the cream becomes relatively warm unless a current of air is maintained, the still or loft system, which was previously used, has been replaced by a system of his own design.

One 40-hp wound-rotor General Electric induction motor is used for driving all of the apparatus connected with the

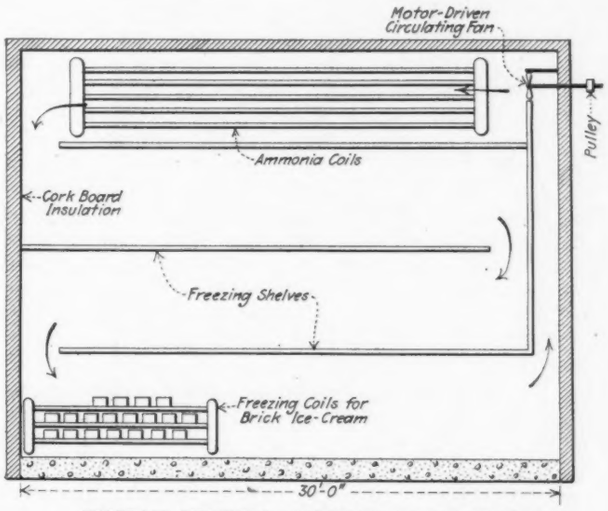


DIAGRAM SHOWING DIRECTION OF AIR PATHS

manufacture of the ice-cream. This method has been found satisfactory as the load on the motor is maintained practically constant and very close to the load at which the motor runs most efficiently. It is the characteristic of a wound-rotor motor, however, to drop off rapidly in efficiency if the load varies from this point very much. Driven from the main shaft by belting are an ice crusher, a deep-well pump, a 20-ton Frick ammonia compressor, four 10-gal. freezing cans, an ice-cream mixer and a Sirocco fan for circulating cooling air through the cold-storage room.

Unless the freezing cans are filled automatically, there is generally a considerable waste in the manufacture of ice-cream. Ice-cream expands to about double its initial volume when frozen, so that a definite quantity should be put in each freezing can. Anything in excess of this amount is wasted, as there is only limited room for expansion. Less than this quantity necessitates the working of the freezers below rating. An automatic system is used by the company for filling the cans which avoids the waste of cream for the reason mentioned.

Forty gallons of ice-cream are frozen to the consistency of apple butter every ten minutes in the four motor-driven freezing cans. It is drawn off from the cans at about 18 deg. Fahr. into other cans or bricks, and the freezing operation is completed in the cold-storage room.

Three inclosed shelves about 30 ft. long and 3 ft. wide have been arranged one above the other on each side of the cold-storage room, so that a current of cold air can be conducted along the top shelf and returned along the bottom tiers in succession. The walls of the room are insulated against radiation with cork board and ground cork for a depth of from 11 to 13 in. in addition to the regular building construction. The ceiling is lined with 5 in. of cork and thoroughly asphalted.

In the loft of the room but partitioned off from it is the apparatus used for chilling the air which circulates through the inclosed shelves in the cold-storage room. It consists of ten ammonia coils 29 ft. long and eight pipes high on each side of the loft. A Sirocco fan draws air from the lower tiers of shelving and blows it over the ammonia coils and down through the freezing shelves again. In this way the air is used over and over and stagnant spots of warm air are eliminated. A practically uniform temperature of from 25 deg. to 35 deg. below zero Fahr. is maintained with this system. Mr. Bang has found that while from eight to twelve hours was required formerly to freeze the cream with the still system, only three hours are required with the present system.

For freezing the bricks additional ammonia coils have been installed in one of the lower shelves in the cold-storage room. The pipes are 8 ft. long and are arranged six high and eight deep, 4 in. center to center, so that the ice-cream bricks may be laid in between pipes to hasten the freezing.

In addition to the apparatus named, a 200-gal. butter churn is driven by the main motor. On the second floor of the building is an ice plant, in which about 7000 lb. of ice is made in 200-lb. cans by the flooded system. A 2-hp, 1200 r.p.m., 220-volt, 60-cycle General Electric motor drives the brine agitators. As the ice is pulled it is conveyed directly to the ice-storage room, which is located over the delivery room. An ice crusher built flush with the floor delivers the crushed ice to delivery wagons below.

The ammonia compressor is a double-cylinder, single-acting machine and operates at 100 r.p.m. One cylinder furnishes compressed ammonia for freezing the cream while the other cylinder furnishes refrigeration for the ice plant. The compressor and the main shafting are driven through two separate belts so that either one may be cut out without disturbing the other.

Installation of Collector Rings on a Direct-Current Machine

A 100-kw, 250-volt, 260-r.p.m. six-pole direct-current wave-wound machine having 170 commutator bars is lying idle in our shop. Where should the leads to slip rings be connected to change it to a single-phase machine? Can collector rings be installed without disconnecting the leads from the commutator bars? What would be the frequency and the voltage of the machine? B. C. R.

In a six-pole wave-winding 360 electrical degrees correspond to 120, 240 or 360 mechanical degrees; 180 electrical degrees on the commutator correspond to 60, 180 and 300 degrees. For single-phase operation the two taps should be separated by 180 electrical degrees; that is, one should be at zero and the other at 60, 180 or 300 mechanical degrees. A convenient location is 180 degrees, or one-half way around the commutator. Connection should be made at bars No. 1 and No. 86. The leads need not be disconnected from the commutator. With six poles and at a speed of 260 r.p.m. the cycles per minute would be 780, 13 cycles per second. The voltage between collector rings would be $250 \div 1.4 = 175$ volts.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Cascade Connection.—H. Meyer-Delius.—An illustrated article giving circle diagrams for cascade connections of polyphase induction motors with commutator machines.—*Elek. Zeit.*, May 1, 1913.

Amortisseur Winding.—M. C. Smith.—An illustrated article in which the author first describes the construction of an actual amortisseur (or "deadening") winding built into the field of a synchronous motor and explains its theory by a brief exposition of the principles of operation of the squirrel-cage induction motor. A short discussion (with curves) is made of the effects of the amortisseur winding on the starting characteristics of a motor, while the next section shows its advantages over the solid pole. A simple theoretical explanation is given of certain characteristics of the amortisseur winding which may be observed in the operation of motors thus equipped, while another section indicates the advantages of this construction in preventing hunting and in improving the operation and regulation of single-phase alternators.—*Gen. Elec. Rev.*, April, 1913.

Variable-Speed Generator.—A note on a recent British patent (No. 1205, 1913) of T. W. Tattersall. To regulate the output of an automobile axle-driven generator three field windings are provided, namely, shunt and series windings and a balancing series winding, which is in series with an iron wire or other resistor having a high positive temperature-resistance coefficient.—London *Elec. Eng'ing*, April 17, 1913.

Lamps and Lighting

Half-Frosted Incandescent Lamps.—A. J. Makower and U. A. Oschwald.—An account of experiments in which the variation in candle-power due to frosting was investigated. Eight lamps were experimented with. A distribution curve over the lower hemisphere having been taken for each of the lamps unfrosted they were frosted over the lower half

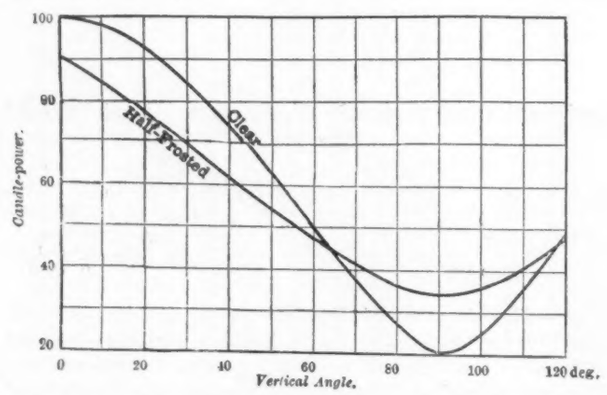


FIG. I—CURVES SHOWING RESULTS OF TESTS OF LAMPS

of the bulbs and re-tested under the same conditions as those of the original test. The horizontal candle-power of each lamp with the bulb unfrosted was called 100 units, and all other candle-powers of the lamp before and after frosting were reduced to this basis so as to facilitate comparison of the distribution curves. The results of the test for a 100-volt, 25-watt tungsten lamp are given in Fig. 1. The candle-power of the lamp is reduced by the frosting from 100 to 90.8 in the horizontal direction and increased from 20.5 to 34 in the vertical direction. The mean hemispherical candle-power of the lamp with clear bulb is 77.5 and that with half-frosted bulb 67.9 units.—London *Electrician*, April 25, 1913.

Generation, Transmission and Distribution

Cost of Oil Engines.—A. N. Rye.—An article on the cost of gas and oil engines for electric supply stations, giving data of cost, etc., from actual practice. The author concludes that internal-combustion engines can give a perfectly satisfactory supply, particularly if batteries are installed, but they are essentially different from a steam plant and must be installed and run with due regard to this fact. Under favorable circumstances these machines are economical, but it must not be forgotten that there are other expenses besides the fuel bill, and the fuel bill of the internal-combustion engine must show a handsome saving to justify the use of this class of plant. The Diesel oil engines appear to have certain advantages over gas engines for central-station work, but as long as the price of oil is subject to such severe fluctuations the use of this engine is likely to be restricted to special cases. The most useful field for the internal-combustion engine appears to be in small central stations. As the size of the station increases the advantages of this type of plant decrease, until a point is reached where internal-combustion engines can pay only in exceptional circumstances, and at the present date this point appears to be reached when a station under average English conditions is of sufficient size to use steam turbines of 1000 kw or larger. The results in Guernsey have fully justified the installation both of gas and oil engines, the great saving in the fuel bill being more than sufficient to balance the increased costs in other directions.—London *Elec. Review*, May 2, 1913.

Traction

Single-Phase Commutator Traction Motors.—S. B. Smith.—The conclusion of his paper presented before the (British) Institution of Civil Engineers. The characteristics of single-phase commutator motors and the means for overcoming their limitations are now fairly well known, and it remains to be seen whether these machines can be made to satisfy the severe requirements of traction work. Though the motors possess nearly all the undesirable qualities that a machine for such duty could possess, these requirements have been made none the less severe for that reason. On account of space, cost, efficiency, simplicity of control, mechanical considerations, etc., it has been found necessary to reduce the number of units on the locomotive to a minimum, so that single units of 800 hp, 1200 hp and even 2000 hp will be commonly met with. Such machines can no longer be built about the driving axles, but have to be placed in the body of the locomotive. To transmit this power to the driving axles, gearing through toothed wheels, or, what seems to be gaining favor, a direct drive through cranks or through an idle counter axle must be adopted. The speed of such motors may vary from 2000 to 500 r.p.m., while the diameter of the driving wheels may be anything from 3 ft. up to 6 ft. It would scarcely seem possible that motors of the repulsion type—burdened with lim-

itations as they are—can ever be made to withstand the severe conditions of long-distance traffic. The ultimate solution of the single-phase commutator motor for railway work will doubtless have to be sought in some form of the series type. The cross flux necessary for commutation can be provided either by means of a local commutating pole, as in the compensated series motor, or by means of a winding spread over the whole pole pitch, as in the series repulsion motor. Both methods are adopted in practice. In the former fewer exciting ampere-turns are required; in the latter energy is also transmitted on the repulsion-motor principle. With all single-phase locomotives for large outputs it is necessary to provide ample ventilation on account of the large amount of heat developed. In this respect locomotives equipped with series motors suffer badly, for not only is there the heat due to the losses in the motor (or motors) to be got rid of—which is about twice the amount that would be developed in continuous-current motors of like output—but there is also that dissipated by the transformer. The output of this transformer must equal that of all the machinery on the locomotive, including that of auxiliary motors for pumps, lighting, etc. In addition, it is also usually necessary to have an induction regulator to prevent jerking when starting and when passing from one tapping point to another, which might otherwise cause mechanical trouble, apart from the discomfort to passengers. This is another source of heating on the locomotive. Altogether, then, there is a very large amount of heat to be got rid of, and with the extra losses at starting the ventilation problem becomes exceedingly difficult. In face of all these drawbacks, therefore, it is not to be wondered at that the single-phase motor has so many active opponents and that all other possible alternatives are being vigorously studied. As yet, however, no better scheme has been forthcoming, and it must be left for the future to show whether an alternative method is possible.—London *Electrician*, May 2, 1913.

Railless Traction.—MAX SCHIEMANN.—A profusely illustrated lecture on the latest developments in railless traction, the cars being supplied with direct current or alternating current for overhead trolley wires by means of flexible arms.—*Elek. Zeit.*, April 24, 1913.

Electric Locomotive for Industrial Plants.—F. RIEP.—The first part of an illustrated article on electric locomotives supplied with current from an overhead trolley wire for mines, industrial works and sidings.—*Elek. Zeit.*, April 24, 1913.

Storage-Battery Traction.—H. BECKMANN.—An illustrated article on the modern practice of using storage batteries on electric locomotives, motor cars, yachts, etc.—*Elek. und Masch.* (Vienna), April 20, 1913.

Installations, Systems and Appliances

Symbolic Load Curves for Electric Stations.—CARL A. ROSSANDER.—If all load curves of a central station during a year are decomposed into elements of, say, an hour, and the load elements thus obtained are arranged not according to their succession in time, but according to their absolute value, a curve is obtained extending over the whole year and beginning with the current $i = 0$ and ending with $i =$ maximum load current i_{max}. The abscissa of the total curve represents 8760 hours, and if the load current during $8760/x$ hours was below i_{max}/y, the ordinate i_{max}/y corresponds to the abscissa $8760/x$, when the scale of the abscissas is hours. The author shows that in many cases it is possible to find a mathematical curve from a few characteristic data of the load conditions in such a way that this curve can be used instead of the empirical curve defined above without any serious error. This curve is given by the equation

$$i = e_0 + (1 - e_0)\, t^m,$$

where f is the current, t the time, e_0 the ratio of the minimum load current to the maximum load current, e the ratio of the total ampere-hours produced during the year to $8760\, i_{max}$, and $m = \dfrac{1 - e}{e - e_0}$. This curve is called the symbolic load curve and it is shown that it can be used with an accuracy sufficient for practical purposes to solve various problems of central-station practice.—*Elek. Zeit.*, May 1, 1913.

Operation in Parallel.—A. GAVAND.—The author describes a case from practice in which parallel operation of two alternators connected through the intermediary of transformers led to surging troubles, and gives the mathematical theory of the origin of the oscillations.—*La Lumière Elec.*, April 26, 1913.

Switchboards.—C. H. SANDERSON.—A continuation of his long serial on switchboards for alternating-current power stations. In the present instalment the discussion of remote, mechanically controlled switchboards is continued and profusely illustrated.—*Elec. Journal*, May, 1913.

Electric Heaters.—H. O. SWOBODA.—An article giving details of the materials used for electric conductors, thermal conductors and electric and thermal insulators in the construction of electric heaters.—*Elec. Journal*, May, 1913.

Wires, Wiring and Conduits

High-Tension Insulators.—ALEXIS MARTIN-SAXTON.—An article on a study of insulators for emfs above 5000 volts. He discusses first what takes place in the dielectric, his discussion being based on the hypothesis that in air between two charged conductors there is a series of alternately electrified zones, one being positive and the next negative. He discusses what happens in an insulator while it is placed under increasing tension. He then takes up the dimensions and form of construction of insulators and discusses the tests to which they should be subjected.—*La Revue Elec.*, May 2, 1913.

High-Voltage Cables.—L. LICHTENSTEIN.—An illustrated paper presented before the Dresden Electrical Society on the manufacture and the electric properties of high-voltage cables with special reference to a new joint of the Siemens-Schuckert company. The author then discusses the problem of testing cables after they have been laid in the ground and supports the recommendation of Delon to use direct current for this purpose.—*Elek. Zeit.*, May 1, 1913.

Electrophysics and Magnetism

Correlation of Magnetic and Physical Properties of Steel.—A note on the co-operative research of the Bureau of Standards and the American Society for Testing Materials with the aid of the American Institute of Electrical Engineers. The investigation on the correlation of the magnetic and mechanical properties of commercial steels with a view to discovering some simple magnetic test which may replace some of the mechanical tests and thus avoid the destruction of the material under examination is still in progress. A large amount of data has been collected, and in every case investigated there have been magnetic differences between specimens which had mechanical differences. The outlook is very promising. For example, in a certain grade of steel such as is used in springs and tools the magnetic tests showed whether or not it had received the proper heat treatment to give it the desirable mechanical properties. If the material is not satisfactory, the same magnetic test shows whether the defect is in the nature of too great brittleness or too little mechanical strength. Another test on this same material will show whether it has been subjected to local strains beyond the elastic limit. In another case a steel rail which had broken in service and in which the microscope showed the presence of transverse fissures had a decidedly lower permeability than a similar rail of the same composition which had never been in service and which showed no such transverse fissures. Defects in certain low-carbon steel bars have been produced

in various ways—for example, by bending, nicking, stretching, drilling holes, etc.—and in every case the good and the defective material have shown characteristic differences.—*Journal Franklin Institute,* April, 1913.

Transient Phenomena.—H. W. Linke.—An analytical investigation of the transient phenomena produced when electrical machines or apparatus are connected to a line or short-circuited, etc.—*Archiv. f. Elek.,* Vol. I, 1913; briefly abstracted in *La Lumière Elec.,* April 26, 1913.

Sensibility of Photo-Electric Cells with Alkali Metals and Hydrogen.—J. G. Kemp.—An account of a systematic quantitative study of the conditions of sensibility of photo-electric cells of alkali metals with hydrogen and a determination of the work required to draw an electron out of an atom. The following facts are established by this investigation: Owing to the low melting temperature of cæsium the use of this metal in photo-electric cells for photometric use is very impractical. The temperature at which it is best to operate a potassium cell is about 25 deg. C. Cooling the potassium cell much below 25 deg. C does not increase its sensitiveness. The sensibility of a potassium cell can be increased more than a hundredfold by the process of forming the hydride surface. The distance between the electrodes for best sensitiveness is about 0.5 cm. The hydrogen gas pressure at which the cell is most sensitive lies between 2 mm and 3 mm of mercury. The potential difference applied to the electrodes for most sensitive conditions is about 330 volts. The minimum energy required to produce an ion by collision was calculated from the data and found to be of the order 1.77×10^{-11} ergs, while the theoretical value determined is 1.63×10^{-11} ergs. Assuming that the straight lines obtained which show the relation between current and intensity of illumination hold for exceedingly small intensities, then by using a tilted electroscope of sensibility 10^{-15} amp, a candle could be detected at a distance of 2.7 miles. This indicates that it is highly probable that a photo-electric cell could be used in astrophotometric work. —*Phys. Review,* April, 1913.

Spectral Analysis and Electronic Theory.—Spies.—An account of an experimental lecture delivered before the Electrical Society of Cologne on the relations between spectral analysis and electronic theory. The fundamental point is that what oscillates in light is nothing but the electrons. The author discusses optical resonance as deduced from the theory of oscillations of electrons and the Zeaman phenomenon.—*Elek. Zeit.,* April 25, 1913.

Cathodic Sputtering.—G. W. C. Kaye.—An abstract of a (British) Physical Society paper giving an account of the volatilization of an aluminum cathode in a discharge tube containing helium. The sputtered deposit on the glass indicates that, under the conditions which prevailed, the disintegration was restricted to the edges of the cathode and did not occur elsewhere. Accordingly the complete outline of the cathode (made by rolling a sheet of aluminum into a nearly complete cylinder) was traced out by the deposit on the walls of the tube.—London *Electrician,* April 25, 1913.

Electrochemistry and Batteries

Carbon Electrodes for Electrolytic Cells.—Joh. Oarden. —An article giving notes on the manufacture of carbon electrodes for electrolytic cells and the testing of such electrodes with respect to homogeneity and grain, absence of cracks and flaws, porosity and specific weight, contents of inert material, electric conductivity, and resistivity to corrosion.—*Met. and Chem. Eng'ing,* May, 1913.

Resistance of Graphite and Carbon.—E. F. Northrup.—An article describing some effects of temperature upon the resistance of carbide and carbon. The following experiment illustrates the difference between graphite and carbon. A rod of graphite and a rod of carbon were selected, each 1.25 in. long and 0.25 in. in diameter. These were used to connect together two plates of graphite. Two holes were drilled in each plate of graphite into which were inserted, for a distance of 0.25 in., the ends of the carbon and the graphite rods. The graphite plates were connected to the low-tension side of a 2-kw transformer, which yielded, with 110 volts on its primary, 22 volts on open circuit on its low-tension side. A rheostat was put in the primary side of the transformer to limit to an approximately constant value the current delivered by the secondary. On closing the circuit the graphite rod came quickly to incandescence while the carbon rod, in parallel connection with it, remained for a time dark, because of its higher resistance at a moderate temperature. After a fraction of a minute the carbon rod began to heat, and in doing so its resistance rapidly lowered so that it took more current than the graphite rod, and it in turn became brilliantly incandescent, while the graphite rod greatly declined in brilliancy. The writer concludes that, for small laboratory furnaces at least, graphite makes a better resistor material than ungraphitized carbon.—*Met. and Chem. Eng'ing,* May, 1913.

Corrosion of Iron.—B. Lambert.—A paper read before the Faraday Society on the electrolytic theory of the corrosion of iron with reference to the properties of chemically pure iron considered in connection with the electrolytic theory of corrosion.—*Met. and Chem. Eng'ing,* May, 1913.

Units, Measurements and Instruments

Exhibit of Instruments.—H. Armagnat.—An illustrated description of the most prominent exhibits at the recent instrument exposition of the French Physical Society in Paris. Some of the exhibits are described in separate notes in the *Digest.*—*La Revue Elec.,* May 2, 1913.

Sensitive Photo-Electric Cell.—A. L. Hughes.—During the course of a research it was found necessary to measure the transparency of a quartz plate over a considerable region of the spectrum. To effect this, use was made of the law that the photo-electric effect is proportional to the intensity of the light. The following cell was found to be extraordinarily sensitive. As shown in Fig. 2, it is a pear-shaped flask to which a quartz plate *Q* is joined by sealing wax. Communication with the electrodes is made by means of platinum fused into the glass, so that the only waxed joint in the cell is that between the quartz plate and the flask. The illuminated electrode is a thin layer of sodium which covers the whole of the inside of the flask, and the other electrode is a brass rod projecting into the flask.

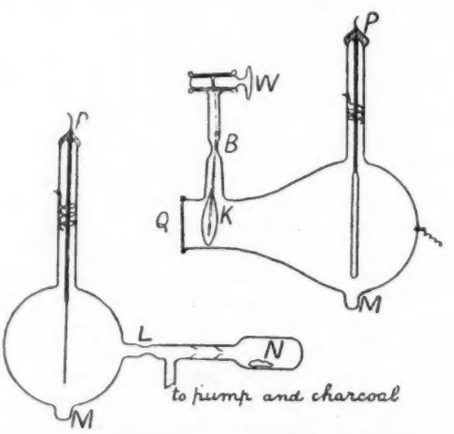


FIG. 2—SENSITIVE PHOTO-ELECTRIC CELL

This is the electrode which is connected to the electrometer, and therefore it must be well insulated. The glass tube around the platinum wire at *P* is warmed and covered with sealing-wax, which is a good insulator. If the apparatus is properly dried and evacuated, the inside of the glass tube near *P* insulates perfectly. Sodium, which is introduced into the bulb *N*, is strongly heated to drive off gases which

are removed by a Toepler pump and charcoal in liquid air. Meanwhile the cell is warmed to drive off condensed gases and vapors from the walls. The apparatus is then tilted so as to cause the melted sodium to pass through the traps and constriction *L* into the small bulb *M*. The sodium in *M* is now heated until the inside of the flask becomes covered with a layer of distilled sodium. To prevent any deposition on the quartz window, the following device was employed. A piece of thin lead foil (shown obliquely at *K*) is cut so as to fill the cross-section of the tube and this foil is held up by a thin glass rod, which in turn is suspended from the winch *W* by a silk thread. When sufficient sodium has been distilled the lead foil is raised by means of the winch and is crumpled up in the side tube out of the path of the light. The blow-pipe is then applied to the constriction *B*, which collapses around the glass rod and is sealed off. Finally the apparatus is sealed off at *L*. A very convenient way of measuring the photo-electric current was to balance it against a current through a suitable xylol-alcohol resistor. The following test was made on the sensitiveness of the cell: The wave-length λ 4360 was isolated by a monochromator, the aperture ratio of the lenses being about f. 5. The slits were 2 cm by 2 mm. The power absorbed by the mercury lamp was 120 watts. The photo-electric current obtained with the cell was as large as 580×10^{-11} amp.—*Philos. Mag.*, May, 1913.

Telegraphy, Telephony and Signals

Physiological Radio Receiver.—An account of the researches of Lefeuvre on using muscular contractions by electric currents for recording the minute currents which occur in radio-telegraphic receivers. With a frog's leg mounted in connection with a recording drum, he receives the radio signals coming from the Eiffel Tower station at Paris, 200 miles dlistant, and the waves are recorded with precision upon the drum. In Fig. 3 *A* is the antenna, *S* the tuning coil, *D* a Ferrié electrolytic detector, *R* a pair of 4000-ohm telephones, and *P* the potentiometer. Wires are taken off in parallel from the telephones and lead to

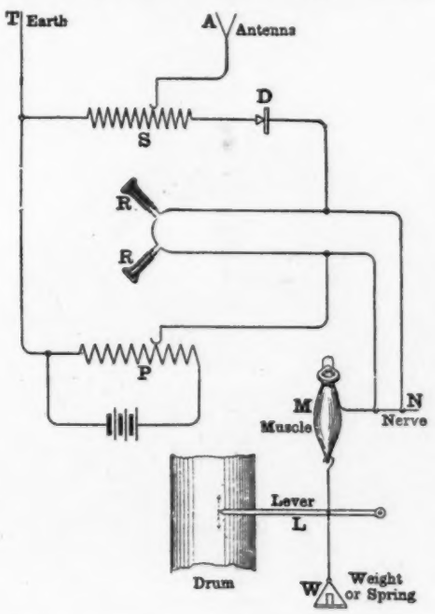


FIG. 3—CIRCUIT DIAGRAM FOR RECORDING MINUTE CURRENTS

the nerve of the frog's leg. The contractions of the muscle act upon a lever so that they are magnified and recorded upon a rotating drum.—London *Electrician*, April 25, 1913.

Miscellaneous

German Electric Patents.—E. BUTZMANN.—Some statistical data on the activity of the German Patent Office in 1912. The number of new patent applications made during the year in the electrical class has now reached 3009. By passing the 3000 mark a record has been set which has not been equaled so far by any other class. The number of new applications in the electrical class has always been high in recent years, being 2846 in 1909 and 2987 in 1911. Applications numbering 2986 were carried over from former years into 1912 (of these one was carried over from 1905 and four from 1907). The total number of patent applications finally acted upon in 1912 was 3068. Of these, 1006 patents were finally granted. The total number of German electrical patents has thereby increased to 15,955, of which 4041 were still in force at the end of 1912. Only twenty-six patents granted fifteen years ago were still in force. This is due partly to the rapid progress of electrical engineering and partly to the "enormous amount of annual fees."—*Elek. Zeit.*, May 1, 1913.

Book Reviews

ELECTRICAL PHOTOMETRY AND ILLUMINATION. By Hermann Bohle. Philadelphia: J. B. Lippincott Company. 222 pages, 200 illus., 35 tables.

A textbook designed for the use of students in technical colleges. It is clearly written, mainly from the standpoint of British practice. The seven chapters of the book are devoted to the following subjects: Photometric units and standards, radiation and its effects, photometric apparatus, light flux and distribution, testing of electric lamps, the design of reflectors and shades, illuminating engineering. The formulas presented are simple and easily remembered. Theories are only very briefly referred to. Practical examples are presented abundantly in diagrams, tables and examples. The book will be useful to the student and practitioner of illuminating engineering.

THE DYNAMICS OF PARTICLES AND OF RIGID, ELASTIC AND FLUID BODIES. By Arthur Gordon Webster, A.B. Second edition. Leipzig, Germany: B. G. Teubner. New York: G. E. Stechert & Company. 588 pages, illus. Price, 14 marks.

An excellent advanced mathematical treatise on dynamics, intended as a textbook for mathematical physicists. The chapters treat of the following subjects: Laws of motion, particular motions of a material point, work and energy, least action, oscillations, instantaneous motion, dynamics of rotating bodies, Newtonian potential function, dynamics of deformable bodies, statics of deformable bodies, hydrodynamics. The treatment is often abstruse but is powerful, original and definite. As a textbook of mathematical dynamics of simple bodies it is one of the best in the English language, which contains a goodly number of such books.

PROBLEMS IN PHYSICAL CHEMISTRY WITH PRACTICAL APPLICATIONS. By Edmund B. R. Prideaux, D.Sc. New York: D. Van Nostrand Company. 312 pages, with mathematical chart; illus. Price, $2.

An excellent textbook on physical chemistry, intended for college students and also suitable as a reference textbook for chemists, physicists, engineers and scientists generally. The book is divided into eight sections, dealing with the following topics: Units, thermochemistry, systems of one component, mixtures, gas reactions, reactions in solution, electromotive force, kinetics of molecular and radioactive changes. It is filled with numerical examples and illustrative problems. It contains a brief chapter on the mathematical processes most commonly employed and adds a short table of logarithms. From the standpoint of a reference textbook on modern physical chemistry the work is one deserving of high commendation.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Electric Time Switch

The Reynolds Electric Flasher Manufacturing Company, Chicago, is now placing on the market a weatherproof one-day time switch for use in any convenient place inside or out of doors.

ONE-DAY TIME SWITCH

The clock is of standard make and requires no other attention than daily winding. The switch mechanism is mounted on a porcelain block and the tripping arrangement is of simple construction. The cabinet is provided with a door at the back to permit easy access to all of the winding levers, switch set, wiring, etc.

This switch is suitable for turning off electric signs, show-window lamps, store or hall lighting, isolated street lamps, patrol alarm systems and numerous electrical installations of a similar character.

Heavy-Duty Internal-Combustion Engine

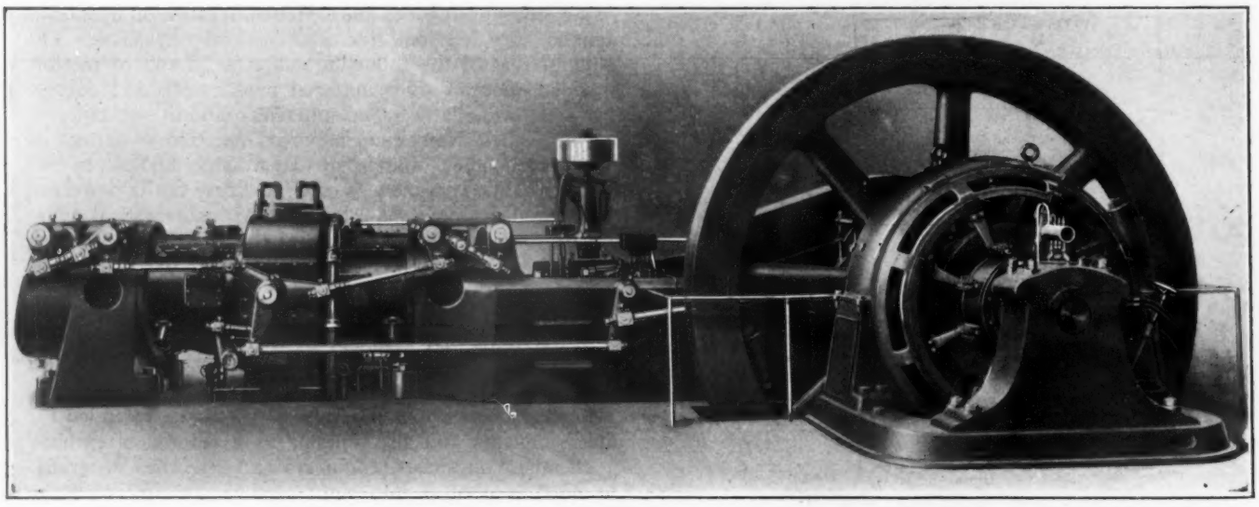
An internal-combustion engine of the double-acting, two-stroke type, known as the Illmer gas engine, has been placed on the American market by the Reading Iron Company, Reading, Pa. In Europe this type of engine has been made for some years and units rated at 2000 brake-hp are now successfully operated there.

Simplicity is the keynote in the design of this engine. Comparing the working parts of this engine and those of a tandem double-acting four-stroke engine, the only arrangement of that type suitable for high-power service, it will be found that there are forty-five or more working parts in the latter as compared with seventeen in the Illmer type.

The scavenging of the cylinder in the Illmer engine embodies an improvement. The conveying conduits turn the working fluids and impart to them a direction of flow parallel to the cylinder axis, producing final longitudinal movement before discharging through the inlet port. The inlet valve, which is of the poppet type, acts as a baffle to the incoming charge and causes the charge to enter the cylinder in the shape of a hollow cone. In this manner the charge is well stratified and fills the cylinder to the maximum of its volumetric capacity. Owing to the generous port opening, it has been found that a pressure of from 1 lb. to 2 lb. per sq. in. is sufficient to drive the charge into the cylinder. Pump cards taken when the piston speed of the engine was 700 ft. per minute show that the power required to drive the pump is somewhat less than 5 per cent of the indicated horse-power of the engine. The charging pump has been made double-acting and so fulfils the duty of the separate air pump and gas pump.

Being of the two-stroke type, it has been possible to use the piston-controlled exhaust port, and the operation is less troublesome than is usually experienced with the poppet-type exhaust valves. Since the inlet valves are not subjected to severe heating as are the exhaust valves, the poppet type can be made to serve very well in that position. The inlet valves are positively actuated both in opening and closing by means of an eccentric. The motion is imparted to the valves through a double-toggle linkage shown in the accompanying illustration.

The piston of this engine is arranged for water cooling, the water being introduced through the hollow piston rod. Arrangements for cleaning the interior of the piston are made by constructing it in halves and bolting it together. Twelve snap rings resist piston leakage and offer a factor of safety against ring breakage. Lubrication of the piston is facilitated by its considerable length. Eight lubricator plugs furnish the oil to the cylinder. All other important parts of the engine are lubricated by a flush-oiling system, the oil being drained to a central filter before being returned to the bearings.

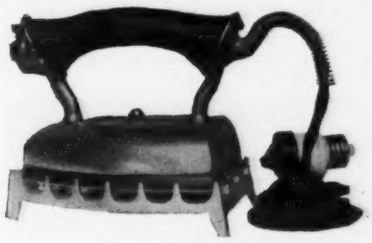


DOUBLE-ACTING TWO-STROKE GAS ENGINE DIRECTLY CONNECTED TO GENERATOR

Notwithstanding the relatively long stroke of the double-acting two-stroke engine, the over-all floor area is less than that occupied by a short-stroke, tandem, double-acting, four-cycle engine.

Variable-Heat Electric Iron

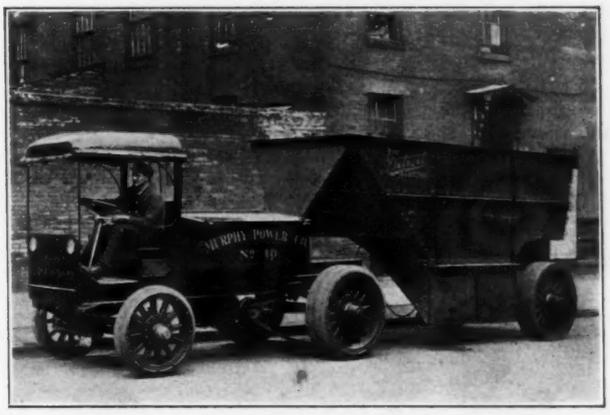
In most cases the cord is attached to an electric iron by a plug, the heat control being effected by means of the plug or otherwise. In the "Garland" iron, made by the Michigan Stove Company, the cord is permanently attached to the iron and the current is turned on and off by means of a switch at the end of the handle. This switch is so placed that it can conveniently be operated by one finger while the iron is being used, thereby affording a simple method for keeping the iron at any desired temperature. The iron is said to be so designed as to concentrate most of the heat at the point and bottom edges, which strike the moisture first.



ELECTRIC IRON WITH SWITCH ON HANDLE

Twelve-Ton Electric Tractor and Trailer

The electric tractor and trailer illustrated herewith was made by the Anderson Electric Car Company, Detroit, Mich., for the Murphy Power Company of the same city. It was designed for the transportation of coal from the yards to the company's power plant. The carrying capacity of the trailer is 12 tons and the tractive effort of the tractor is said to be ample for handling this load under the local road conditions. The tractor is equipped with sixty battery cells of the Edison Storage Battery Company's make, type A-12. The motor is of series-wound type rated at 85 amp and is made by the Anderson Electric Car Company.



TRACTOR AND TRAILER

Small Series-Type Alternating-Current Motors

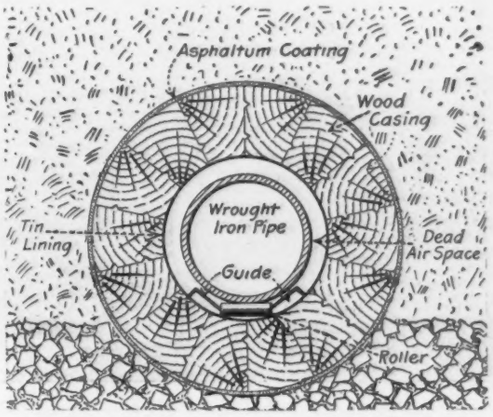
The Victor Electric Company, Chicago, has recently brought out a line of small series-type alternating-current motors the most interesting features of which are said to be practically sparkless commutation and nearly perfect control. The motors are built in two sizes of ⅛-hp and ⅙-hp rating. They are designed for operation at 110 volts and 60 cycles, 220 volts and 60 cycles, 110 volts and 25, 30 or 40 cycles, and 220 volts and 25, 30 or 40 cycles. All are built in the same frame, which is approximately 6.5 in. wide, 7 in. high and 9.75 in. from end to end of shaft, the shaft protruding 1⅛ in. from the end bearing. The field as well as the armature cores are built up of specially annealed Swedish-iron laminations and the commutator is made of a specially tough copper composition. The motors are made either semi-inclosed, entirely inclosed with the exception of external binding posts, or entirely inclosed without external binding posts, the leads in this instance being brought out at the top of the motor and incased in conduit.

One type has been especially designed for the operation of any apparatus requiring full torque, such as washing machines, vacuum cleaners, carbonators and many other devices that are likely to be overloaded at some time. There are no starting devices, consequently nothing to burn out if the motor should become overloaded. The speed of this type can be controlled with a separate rheostat similar to those used on direct-current motors.

ALTERNATING-CURRENT SERIES MOTOR

Steam-Pipe Casings

An essential point in long-distance transmission of steam and hot water for heating and other purposes is to obtain an efficient non-conducting pipe covering. A casing for such purposes which is said to reduce the condensation and radiation losses to from one-quarter of 1 per cent to three-quarters of 1 per cent per mile of pipe is now manufactured by the Michigan Pipe Company, Bay City, Mich. The illustration shows a cross-section of this system of pipe insulation. Tamarack wood is used for the shell, this being a coarse-grained, very hard and tough material. The inside is lined with a reflecting and protecting coating of bright tin and the outside is protected by a coating of asphaltum cement. Pipe guides are used to hold the iron pipe concentric with the wood casing, and in sizes above 5 in. the

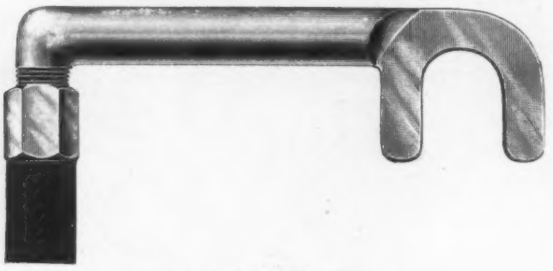


CROSS-SECTION OF PIPE CASING

guides have roller bearings. The casings are shipped ready to lay, the operation of laying merely consisting in placing each section together in the trench and making a driving fit. The ends of each section are treated with a creosote preparation which protects the only exposed portions during transportation and installation.

Rheostat Terminal

A terminal connector for joining the dial to the grids of field rheostats is shown in the illustration. The shank of



TERMINAL CONNECTOR

the connector is elongated so as to admit the cable in a direct line, while the contact disk is slotted to fit over the grid and is offset slightly to the right or left respectively to facilitate the work of installation. This connector is made by Dossert & Company, New York.

Indirect Lighting in Department Store

In the Plate Glass Block, a large department store in Duluth, Minn., use is made throughout of the indirect-lighting system with results said to be much more satisfactory than those obtained formerly with arc lamps. On the main floor, where dress goods, silks, linens and men's furnishings are displayed, twenty-seven fixtures have been found sufficient to give the required illumination. No additional conduits were laid, as the old arc-lamp outlets were

FIG. 1—INDIRECT LIGHTING ON FIRST FLOOR

utilized in each case. Fig. 1 shows a view of the first floor entirely illumined by artificial light.

On the second floor, which is devoted to the display of cloaks and suits, twenty-two units were installed. Owing to the predominance of dark cloth, the intensity required is high, namely, 4 ft.-candles, which is said to have proved entirely satisfactory. Fig. 2, which is a view of this floor, shows that practically all shadows are eliminated.

Ample illumination was obtained on the third floor, where millinery, lingerie and pictures are sold, by the use of twenty-two fixtures, and the true colors in rugs and draperies on the fourth floor were brought out most satisfactorily by the subdued light from similar fixtures.

Desk lamps were entirely dispensed with in the offices after the new installation. The units now employed are of

FIG. 2—ILLUMINATION IN SUIT AND COAT DISPLAY ROOM

the 250-watt tungsten type. No trouble has been experienced from light being reflected by glass-topped showcases since the installation of the indirect-lighting system.

All of the fixtures were furnished by the Central Electric Company of Chicago and are of the type known as "Alexalite."

Electricity Applied to the Shoe-Shining Art

The Sanax Company, of 125 East Twenty-third Street, New York, has found a new field for its "Foen" portable hot and cold air blower. A very large sale is claimed for

DRYING SHOES ELECTRICALLY

it in hotel, restaurant and other bootblack stands for use in hastening the shoe-shining process. Motor, fan and heating element in this device are all inclosed in a strong light case of aluminum and the switch is the only exposed part, so that it can withstand the rough usage that it would be likely to receive in this service. The accompanying cut shows the facility with which the device can be applied to the above-mentioned work.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Electric Hoist Business Not Suffering.—In a recent talk with one of the large manufacturers of electric hoisting apparatus it developed that in this line no diminution in the volume of business had been noticed and that the outlook was considered to be satisfactory in every way.

More Space for Electric Washer Company.—The Maytag Company, Newton, Ia., which builds electric washing machines, is about to commence work upon a new gray-iron foundry, 400 ft. by 90 ft. This is to cost about $50,000 and has become necessary on account of the continual increase in the company's business.

Steam-Turbine Business Normal.—The De Laval Steam Turbine Company, of Trenton, N. J., writes as follows: "General business conditions in our line at the present time seem to be about normal and as far as we can see they will continue so. The proposed tariff changes have no direct effect on our product."

Waterwheels for Plant at Fountain Falls, Can.—The Northwestern Ontario Light & Power Company, Ltd., has placed an order with the I. P. Morris Company, Philadelphia, for two waterwheels for its Fountain Falls development near Cobalt, Ontario, Canada. The contract covers two 1500-hp vertical-shaft, single-runner turbines which are to operate under a head of 30 ft.

Insulation Maker Enlarges Plant.—Like many other manufacturers of electrical equipment at the present time, the Hemming Manufacturing Company, Garfield, N. J., the product of which is heat-resisting molded insulation, has found it necessary to enlarge its facilities in order to handle the increasing volume of business in its line. On this account the company has trebled its plant equipment.

Mexican Disturbance Causes Depression.—A firm of well-known exporters reports that the recent revolution in Mexico and the subsequent governmental turmoil have caused a decided falling off in the volume of business in that country. The sales of electrical machinery and supplies have been decreased by approximately 75 per cent and at the present time show little indication of recovering their former volume.

Steam-Boiler Business Not Brisk.—From interviews with several of the smaller concerns supplying steam-boiler equipment and accessories it was learned that following a period of exceptional activity in this line there has been a tendency for business to fall off of late. While replacements are being obtained at a good normal rate the volume of new business has decreased because of the lack of new developments owing to present money market conditions.

Steel-Pole Manufacturing Not Hampered by Fire.—The Franklin Steel Company, Franklin, Pa., stated that its transmission and lighting pole department was not injured by a fire which took place recently at its plant and that it is still in a position, therefore, to handle orders for that line of equipment. Nearly $200,000 of damage was done in other departments, however, the bar mills being destroyed. The mill for 18-in. stock and the assembling shops were not injured.

Expects an Excellent Fan Season.—The Monarch Electric & Wire Company, Chicago, discussing the 1913 fan season, said this week: "We have had a very successful and unprecedented response from our special campaign with Hunter and Tuerk fans. Our agencies number more than double those of any previous year and all we need now is a few days of warm weather to have the largest sale, by far, in the history of the company. These conditions are also true of our other agency lines."

Hurley Machine Company Markets a New Line.—The "Hurley Six" is the name of a new electric vacuum cleaner which has just been placed on the market by the Hurley Machine Company of New York and Chicago, manufacturer of the Thor electric home laundry machine. This cleaner is of the portable type, retails at a popular price and has several new features. One of these is a simple device for picking up threads, lint, ravelings, etc. The company states that a large number of the machines have been sold and that numerous requests for territory are being received daily from all parts of the country.

Chinese Trade in American Electrical Supplies Remains Steady.—Exporters to China report that although recently there have been no shipments of large orders, the trade in lamps and electrical supplies is remaining constant. No immediate falling off in American exports to China has been experienced as the result of the withdrawal of the United States from the six-power loan group, and if the optimistic attitude of the American agents can be taken as a guide no severe hardship will result from the action of the national government in the Chinese loan matter.

New Jobbing House in Binghamton, N. Y.—The Blanding Electrical Supply Company, Inc., has succeeded the Binghamton (N. Y.) Electrical Construction Company, which has been prominent for many years in the electrical contracting and engineering business. In addition to conducting the same lines of business as were handled by the Binghamton Electrical Construction Company in the past. the Blanding company will also carry on an electrical supply jobbing business. The stock of supplies has been increased and additional stock rooms have been taken at 142 State Street, the main office and stock room being maintained at 141 State Street as heretofore.

Oil-Engine Performance.—An oil-engine-driven generating set, consisting of an 18-kw Diehl generator direct-connected to a 30-hp Remington oil engine, was favorably recommended to the government recently for use in connection with wireless-telegraphy service, following a series of tests made upon it by a government representative. At these tests the oils used were Sun oil, Stove oil and Eagle oil. The density of these varies from 27 deg. to 29 deg. Baumé, and some have a paraffin and others an asphaltum base. The fuel consumption per kilowatt-hour shown on these tests was 0.1605 gal. when running on Sun oil, 0.1624 gal. on Eagle oil and 0.1674 gal. on Stove oil.

Appliance Manufacturers Open Pacific Coast Branch.—The Birtman Electric Company, 12 South Street, Chicago, manufacturer of vacuum cleaners, massage vibrators, hair driers and similar appliances, is completing arrangements for opening a branch office in San Francisco. This step has been made necessary on account of the rapid increase in the company's business on the Pacific Coast and the difficulty it has experienced in handling this business properly without local distributing facilities. The new office will be in charge of A. J. Saunders, who will carry a complete stock and handle the distribution for the entire Pacific Coast. The company recently placed an improved line of its Model D suction cleaner on the market.

No Change in General Electric Executive Officers.—For the past month or two there have been very persistent rumors circulated in the business world to the effect that President C. A. Coffin, of the General Electric Company, who is now in his sixty-ninth year, would resign and thereupon be made chairman of the board of directors of the company. E. W. Rice, Jr., vice-president and chief engineer, was said to be the choice as Mr. Coffin's successor, and some of the other vice-presidents were slated for advancement. However, at a meeting of the board of directors held on May 21 no change whatsoever was made and executive officers were re-elected as follows: President,

C. A. Coffin; vice-presidents, E. W. Rice, Jr., Anson W. Burchard, J. R. Lovejoy, J. R. McKee and Owen D. Young; treasurer, Henry W. Darling; secretary, M. F. Westover.

Chicago Fuse Company Busy.—In response to our request for information concerning the present state of its business, the Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, says it is finding trade conditions very satisfactory. "We have noticed but little tendency toward the depression it was feared would take place to some extent as a result of opening up the tariff and other questions in which the present administration is interested," the company adds.

Large Fuse Orders.—The Economy Fuse & Manufacturing Company, Chicago, maker of renewable cartridge fuses, fuse accessories, etc., has received a large order through a prominent Eastern jobber for a quantity of fuses ranging in size from 10 amp to 600 amp, inclusive. This order came from the United States Navy Department, which will use the fuses at the Brooklyn Navy Yard. Another large order received a short time ago by the Economy company came from the Singer Manufacturing Company, Elizabethport, N. J. The material supplied on this order includes a large quantity of the company's ferrule-type fuses in a wide range of sizes and also a large number of knife-blade-type fuses in sizes from 100 amp to 400 amp, inclusive.

Conduit Engineer Receives Large Contracts.—G. M. Gest, conduit engineer, of Montreal and New York, has been awarded the contract for constructing the first section of the underground conduit system as planned by the Montreal Electric Service Commission. There were four tenders submitted, and the commission recommended that the tender of Mr. Gest, at $271,758, be accepted. This will be one of the most complicated pieces of work ever undertaken, the construction being under the sidewalks of St. Catherine Street, the most congested street in the city. Mr. Gest has agreed to complete the work in six months, while the next lowest tender asked twenty-four months. A contract covering the construction of large extensions to the conduit system in Vancouver, B. C., has also been awarded to the same engineer.

Absorption Ice Plant for Chicago Stock Yards.—The Carbondale Machine Company, Carbondale, Pa., recently installed and placed in operation a 50-ton ice plant in connection with a power station for the Union Stock Yards & Transit Company, of Chicago, where all of the local conditions are favorable for making ice at a lower cost than anywhere else in this country. The engines at the stock yards are run non-condensing, with 3-lb. back pressure, throughout the year for heating purposes, the exhaust steam being used in dry kilns, etc., even in the summer months, so that an abundant supply of exhaust steam will be available at all times for the ice plant. From 1,000,000 gal. to 3,000,00 gal. of water is pumped each day through the stock yards, so that no additional pumping will be required for ice-making. The only extra labor will be that needed for pulling the ice.

Mixed-Pressure Turbine Sales Increasing—"Whereas our last year's business showed an increase of about 50 per cent over that of the year before, this year's business thus far is double that in the corresponding period of 1912," said a representative of the George D. Atwood Company, 149 Broadway, New York, this week. This company makes a specialty of mixed-pressure turbine work, furnishing complete equipment for power plants, and is the general Eastern agent for the Kerr Steam Turbine Company, the Northern Equipment Company and the Uehling Instrument Company. One notable installation of this nature will be made in a plant which is being built for the Sicilian Asphalt Paving Company on Newtown Creek, Brooklyn, N. Y. This consists of a 100-kw mixed-pressure turbine generating set, with condenser, rotative dry-vacuum pump and motor-driven circulating pump. The unit is unique on account of its flexibility for several kinds of service. A pulley is to be arranged on the generator shaft, so that 50 hp can be transmitted mechanically from the turbine set to a line shaft, and the set is to be designed to operate either on high-pressure or low-pressure steam or both. It will be possible to drive a mechanical load of 50 hp, with no electrical load, if desired, in which case the set can be run non-condensing, or the latter can develop an electrical load, without having the turbine in operation by connection with the line shaft, or, in the event of the mechanical load being heavy, power can be transmitted to the line shaft, thus reducing the load on the engine. Should the electrical load be heavy and the mechanical load light, power can be transmitted from the line shaft to help out the turbine.

Insulated-Wire Business Reaches Record Proportions.—The Detroit Insulated Wire Company, Detroit, Mich., reports that its business in the first four months of this year was more than 100 per cent in excess of that in the corresponding period of 1912. April was the banner month in the company's history, and from present indications the May business will be even larger than that of April. Orders on hand insure disposal of the entire output for several months, despite the fact that the company's productive capacity was recently increased by extensive additions and improvements to the factory equipment. The export branch of the company's business also shows a decided increase. President Keller feels certain that, barring restrictive legislation, the outlook for continuation of his company's rapid growth is decidedly bright.

Esterline Company's New Plant.—This letter was received recently from the Esterline Company, of Indianapolis, Ind.: "Following the flood at Lafayette, we moved our entire plant to this city. This move had been planned for some time this summer, but after the flood subsided we decided not to re-enter the old plant. We have here a three-story reinforced-concrete factory building with over 100,000 sq. ft. of floor space, which is more than four times the space we had at our Lafayette plant. Business has been exceptionally good during the past month in our meter-sales department, and the outlook in this line is particuarly bright. We do not expect to be bothered by the tariff. We are selling a good many of our lines abroad now, and if we can make them in this country and ship them to other countries, we are not much afraid of the other fellows beating us out here."

Waterwheels for Western Canada Power Company.—At the annual meeting of the Western Canada Power Company, of Vancouver, B. C., C. H. Cahan, K.C., the president, stated that in addition to ordering two additional 13,000-hp double Francis turbines from Escher, Wyss & Company, the directors have given a contract to the Canadian General Electric Company for two generators, and have ordered from the Canadian Westinghouse Company the switchboards and other accessories to double the present rating of the company's generating station. Although under its contract, which was recently completed, the British Columbia Electric Railway Company, Limited, is not required to take electrical energy from the Western Canada Power Company, before Sept. 1 next, that company has already commenced to take 6000 hp. Mr. Cahan added: "The establishment of grain elevators, flour mills and cement mills, together with the new steel works, which will soon be in operation in Vancouver, will insure large increases in our sales of energy, and we must now prepare for the large demand which these industries will certainly make upon us."

Electrical Contractors Expect Much from Society for Electrical Development.—"While we are doing a fair amount of work in Pennsylvania, Virginia and elsewhere outside of New York, we are finding business right here in the local field much lighter just now than it was at this time last year," said one of the members of a New York electrical contracting firm this week. "In fact, as far as our company is concerned, things are very dull, and if it were not for our outside work the amount of business we are doing in New York at present would hardly pay expenses," he continued. "The price-cutting is very severe, too, which indicates that there are a great many others in this line who are willing to take business at nearly any price in order to help meet expenses. I believe that the Society for Electrical Development, when it gets its plans under way, will do some very good work in improving conditions in the entire electrical field. Everyone in the business is certain to be benefited by the society's publicity campaign, even those who are not broad-minded enough

to become members of the society. Just as soon as the plan is placed in operation a great many concerns which have not already joined will do so and with the united efforts of every branch of the industry the latter will surely receive a decided impetus along commercial lines. When the movement was first attempted several years ago the financial troubles in 1907 were so acute that the plan was naturally unsuccessful at that time. The general trade situation is also somewhat unsettled at present, but by the time things brighten up a little the Society for Electrical Development will have all the funds it needs to start its campaign, which, I am sure, will be very beneficial to the entire industry."

Tennessee Hydroelectric Station Nearing Completion.—The hydroelectic station of the Chattanooga & Tennessee River Power Company at Hale's Bar, on the Tennessee River, about 12 miles below Chattanooga, is nearing completion. Energy from this plant, which is to have a rating of 56,000 hp, will be transmitted to Chattanooga and the surrounding territory. A 20,000-hp steam auxiliary station is to be erected by the Chattanooga company.

Meridian (Miss.) Company Improving Its Property.—The Meridian (Miss.) Light & Railway Company, which is one of the subsidiaries of the Consolidated Cities Light, Power & Traction Company, is making a number of improvements to its system. These include the installation of a 2560-hp unit in the generating station, additional cars and 7 miles of new gas mains.

Completes Transmission Lines to Nashville.—Erection of the transmission lines from the hydroelectric plants of the Tennessee Power Company on the Ocoee River to Nashville, Tenn., has been completed and the delivery of energy to the Nashville Railway & Light Company has begun. When the developments of the Tennessee company are completed they will have a rated output of approximately 100,000 hp. Details of the company's plans were given in these columns April 30, 1912.

Doherty Faction Sustained in Toledo Utility Suit.—Judge Killits in the United States District Court at Toledo has handed down a decision in the case of the Toledo Traction, Light & Power Company versus Barton Smith and others, sustaining all acts of the board of directors and officers of the Toledo company nominated by Henry L. Doherty & Company, and declaring their election legal. Details of the controversy over which this suit was brought were given in these columns April 26.

Personnel of E. W. Clark & Company Management Corporation.—As was mentioned in these columns last week, E. W. Clark & Company, of Philadelphia, bankers and one of the oldest concerns in the public-utility field, recently organized a new corporation under Delaware laws to take over their engineering and management departments. The newly formed company is known as the E. W. Clark & Company Management Corporation and its principal operating office will be at Columbus, Ohio. It was first called the E. W. Clark Management & Engineering Company, but this name was changed to that given above. The officers are: President, C. M. Clark; vice-presidents, S. G. McMeen and M. S. Hopkins; secretary and treasurer, G. L. Estabrook; assistant treasurer and assistant secretary, A. F. Burlington.

Westinghouse Electric Earned Record Gross in 1912.—The annual report of the Westinghouse Electric & Manufacturing Company for the year ended March 31, 1913, issued this week, shows gross earnings of $39,977,565, the largest in the history of the company and comparing with $34,196,446 in the previous year. The net income available for dividends was $3,164,032, and this was exceeded only in 1911, when the figure was $4,881,105. Net earnings, after paying dividends of 7 per cent on the preferred stock, were equal to 8.2 per cent on the outstanding common stock, as compared with 6.12 per cent on the same amount of stock last year. Common stock dividends to the amount of $1,053,666 were paid, as against $352,117 in 1911, leaving a balance of $1,830,457 against $1,812,067 on March 31, 1912. Deductions for depreciation, etc., left the total surplus at $7,348,522 as compared with $6,648,964 for the previous fiscal year. The value of unfilled orders as of March 31, 1912, was $8,137,961; as of March 31, 1913, the value of unfilled orders was $12,061,473. The average number of employees during the year was 20,542, as compared with an average of 16,000 for the previous year. In his remarks to the stockholders Guy E. Tripp, chairman of the board, stated that all of the foreign Westinghouse companies, with the exception of the Russian company, showed further improvement during 1912. The outlook for the British and French companies he regards as particularly good. During 1912 the Italian company received large orders from the Italian government for electric locomotives and other equipment, delivery of which is to begin shortly.

Spartanburg (S. C.) Utility Company to Enlarge Its System.—The South Carolina Railway, Light & Power Company, Spartanburg, S. C., is making extensions to its tracks and other equipment and is planning to let contracts in the near future for the erection of a hundred-thousand-dollar steam generating station to be used as an auxiliary to its hydroelectric plant at Gaston Shoals. The company will also erect another hydroelectric plant at Palmer Shoals, about 6 miles above the present plant. This will have a rating of 16,000 hp. The Gaston Shoals plant generates 12,000 hp.

To Consider Financing of New Station.—At the annual meeting of the Columbia Gas & Electric Company, Cincinnati, last week, William P. Philips, of J. & W. Seligman & Company, was elected a director in place of George H. Worthington, of Cleveland. T. R. McCay was named on the board of the Union Gas & Electric Company, a subsidiary of the Columbia company, in place of Theodore Cluss, secretary of the company, and T. F. Wickham succeeded J. T. Carew, resigned. After the elections, the meetings were adjourned for two weeks. It is expected that at the adjourned meetings something of a definite nature regarding the financing of the new generating station to be erected by the Columbia Gas & Electric Company at a cost of $3,000,000 will be presented to the stockholders of the Union company.

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	May 14	May 21
Allis-Chalmers, t.r., 5th pd	$17,196,600	.....	.....	5½	7½
Allis-Chal., pf.,t.r.,5th pd..	14,168,000	.....	.....	11*	15½*
Amalgamated Copper.....	153,887,900	1½	Q	74¾	73¾
American Tel. & Tel.....	344,471,400	2	Q	128½*	128½
Electric Storage Battery,c.	16,074,425	1	Q	47½	47½
General Electric.....	101,348,700	2	Q	138*	138½
Mackay Cos., c.....	41,380,400	1½	Q	82*	82*
Mackay Cos., pf.....	50,000,000	1	Q	68*	68*
Western Union Tel.....	99,747,600	¾	Q	65½	65½*
Westinghouse, E. & M., c.	34,423,550	1	Q	61½	62
Westinghouse, E. & M., pf.	3,998,700	1¾	Q	114*	114*

*Last price quoted.

NEW YORK METAL MARKET PRICES

	May 13 Bid.	May 13 Asked.	May 20 Bid.	May 20 Asked.
Copper:				
Standard, spot	15.37½	to 15.75	.....	15.37½
	£ s d		£ s d	
London, standard, spot	69 18 9		68 8 9	
Prime Lake	15.80	to 15.90	15.70	to 15.80
Electrolytic	15.75	to 15.85	15.55	to 15.65
Casting	15.50	to 15.60	15.40	to 15.50
Copper wire, base		17.00		17.00
Lead		4.35		4.35
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter		7.75		7.50
Spelter, spot	5.50	to 5.60	5.45	to 5.55
Tin, spot		49.75		47.62½
Aluminum:				
Prompt delivery	26.12½	to 26.37½	25.00	to 26.00
Future	26.12½	to 26.37½	25.25	to 26.25

OLD METALS

Heavy copper and wire	14.50	14.87½
Brass, heavy	9.37½	9.37½
Brass, light	8.25	8.50
Lead, heavy	4.25	4.25
Zinc scrap	4.87½	4.50

COPPER EXPORTS IN MAY

Total tons to May 21	25,996

Personal

Mr. N. T. Fortun has been elected manager of the Lyle (Minn.) electric-light plant, succeeding Mr. N. G. Fischer.

Mr. W. N. Chatfield has succeeded Mr. L. C. Phipps, Jr., as treasurer and manager of the Pacific Power Company at Bodie, Cal.

Mr. Charles Schaefer has succeeded Mr. W. H. Hartman as superintendent of the municipal electric-light and power plant at Opelika, Ala.

Mr. Gerald H. Moore has been appointed resident engineer of the Canadian British Engineering Company, Ltd., of Winnipeg, Manitoba.

Mr. C. T. Wheat has succeeded Mr. William McKinley as superintendent of the Madison County Light & Power Company, Carlinville, Ill.

Mr. E. Cutting has been appointed superintendent of the municipal electric-lighting plant at Riverside, Cal., succeeding Mr. F. A. Worthley, resigned.

Mr. Harry Frith has been reappointed commercial manager for the Central Illinois Utilities Company at Watseka, Ill., succeeding Mr. D. B. Maxwell, resigned.

Mr. R. T. Morris, municipal electrician of South Vancouver, B. C., has resigned to associate himself with Mr. G. M. Gest, the well-known conduit engineer and contractor.

Mr. Herbert L. Harries, son of Gen. George H. Harries, has succeeded Mr. P. T. Glidden as manager of the Louisville Lighting Company, with the title of assistant to the president.

Mr. L. W. Byers, until recently general manager of the Atlantic City (N. J.) Electric Company, has been transferred to the New York office of the American Gas & Electric Company.

Mr. P. T. Glidden, until recently general manager of the Louisville Lighting Company, has been transferred to St. Paul to assume the duties of manager of the Consumers' Power Company at that city.

Mr. O. F. Whitehurst, formerly engineer of the Nashville office of the General Electric Company, has been appointed vice-president and general manager of the Capital Light & Power Company, Jackson, Miss.

Mr. John Wise, who has been general manager of the Harwood Electric Company, Hazleton, Pa., has been made general manager of the Lehigh Navigation Electric Company, which has acquired the property of the former company.

Mr. J. W. Lieb, Jr., associate general manager of the New York Edison Company, delivered an illustrated lecture on the engineering features of the Dayton flood before the Yale University branch of the American Institute of Electrical Engineers on May 14.

Mr. Frank H. Golding has resigned his position as general manager for the Rockford (Ill.) Electric Company to accept a position as manager for the Atlantic City (N. J.) Electric Company, effective June 1. He will be succeeded by Mr. Adam Gschwindt, of Scranton, Pa.

Mr. J. J. Roe, president and manager of the Hampton (Ia.) Electric Light & Power Company, has disposed of all his holdings in the company and has been succeeded by Mr. M. A. Harrison, formerly manager of the Nevada (Ia.) Electric Company, who represents the new owners.

Mr. Sydney W. Ashe has completed the work of organizing the educational activities at the Harrison Lamp Works of the General Electric Company, and has been transferred to the Pittsfield works of the same company, where he will co-operate in handling the educational and welfare work.

Mr. Kempster B. Miller, consulting engineer, of Chicago, will sail for Glasgow via Montreal on June 14 and plans to visit Edinburgh, London, Antwerp and Paris. Mr. Miller will be accompanied by his family and after establishing them in Switzerland for the summer he expects to return about the middle of July.

Mr. E. L. Sherwood, formerly district manager of incandescent lamp sales for the General Electric Company at Cincinnati, has resigned and joined the sales force of the National Carbon Company of Cleveland, Ohio. Mr. Sherwood's territory will embrace southern Indiana, southern Ohio, West Virginia, Kentucky and Tennessee.

Mr. W. A. Leland, of Charleston, S. C., has been elected president of the Tennessee Eastern Electric Company with offices in Johnson City, Tenn. This company recently purchased the lighting properties in Johnson City, and is now engaged in building a dam across the Nolachucky River, and will erect a hydroelectric station near Greeneville and distribute electrical energy in eastern Tennessee towns.

Dr. Leo H. Baekeland, industrial chemist, of Yonkers, N. Y., who has won renown among electrical men by the invention of bakelite, an insulating material, and in the photographic field by the invention of velox paper, was the recipient of the third Willard Gibbs medal in Chicago on May 16. The medal was founded by Mr. William A. Converse and is bestowed each year by the Chicago Section of the American Chemical Society upon a man who has gained pre-eminence in chemical research. A banquet was held in honor of Dr. Baekeland at the Hotel Sherman on the evening of the ceremony. This is the first time that the medal has been presented to an industrial chemist. Previously it had been bestowed on pure-science chemists. Mr. W. D. Richardson presented the medal, and Dr. Baekeland responded by reading a technical paper on "Recent Developments in Phenolic Condensation Products."

Obituary

Francis M. Rites, inventor of the Rites governor for steam engines and at one time chief engineer of the Westinghouse Machine Company, was found dead at his country home in Slaterville, N. Y., on May 8. It is supposed that he suffered an attack of acute indigestion and died suddenly about May 2.

Horace G. Burt, chief engineer for the Chicago Association of Commerce committee of investigation on smoke abatement and electrification of railway terminals, died at the Oak Park (Ill.) Hospital on May 19. Mr. Burt was sixty-four years of age. He was a civil engineer by profession and a graduate of the University of Michigan. He had devoted his life to railroad work and was president of the Union Pacific Railroad from 1898 to 1904.

Stephen D. Field, one of the pioneers in electric railways, died at his residence in Stockbridge, Mass., on May 18, 1913. Mr. Field was an inventor in many fields of electrical work and in 1879 and 1880 applied for patents for an electric railway, including a stationary generator, trolley wire, electric car, under-running trolley and bonded rails for return circuit. In 1880 he constructed an experimental electric line in Stockbridge and in 1883, in connection with Mr. Edison, operated an electric locomotive by a third-rail at the Chicago Railway Exposition. He also made a number of inventions in telegraphy. Following his early work he did little in the electric railway field except in the later nineties, when, representing American capitalists, he had engineering charge of the electrical equipment of the tramway system at Geneva, Switzerland.

George D. Rosenthal, district manager for the General Electric Company at St. Louis, Mo., died May 19 in the German Hospital in New York City. He was operated on for appendicitis on May 12 and suffered a fatal relapse a week later. Mr. Rosenthal had been connected with the General Electric Company for nearly twenty-five years. He was born in New York City forty-five years ago. His father was chief statistician for the Thomas A. Edison Lamp Works at Harrison, N. J., before they were consolidated with the General Electric Company. Mr. Rosenthal began his business career with the Edison company as a lamp salesman. After its consolidation with the General Electric Company he went to the Chicago office of the new company as a salesman for railway apparatus. About fifteen years ago he was transferred to the St. Louis office. He was one of the best salesmen in the organization and gradually worked up to the position of district manager. He is survived by his widow.

Construction

New England

MONTPELIER, VT.—The Consolidated Ltg. Co. has decided to erect a new substation in Graniteville to furnish electricity in that vicinity, plans for which will be prepared at once.

AGAWAM, MASS.—The Agawam El. Co. has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue 300 shares of capital stock, at $100 per share, to acquire the property of the Housatonic Pwr. Co. in Agawam.

FALL RIVER, MASS.—The Fall River El. Lt. Co. has applied to the State Gas and Electric Light Commissioners for permission to issue 2000 shares of capital stock at $150 per share ($300,000), the proceeds to be used to pay off floating indebtedness and to meet the cost of additions and improvements to its present equipment and service.

GREENFIELD, MASS.—Work will soon begin on the proposed enlargement and improvements to the Gardner Falls plant of the Greenfield El. Lt. & Pwr. Co., which, it is understood, will double the output of the plant. F. T. Ley & Co., of Springfield, have the contract for the installation of two generating units and corresponding turbines, enlarging the power station and deepening and widening the canal.

PLYMOUTH, MASS.—The Plymouth El. Lt. Co. is extending its transmission lines to Manomet to supply electricity for lamps. A petition is being circulated by the citizens for the installation of street lamps. Preparations are being made by the company to extend its high-tension transmission line from Duxbury to Marshfield to furnish electrical service in the latter place.

WRENTHAM, MASS.—The Selectmen have signed a contract with the Union El. Lt. Co., of Franklin, to light the streets of the town with electricity. The contract calls for 151 tungsten lamps of 40 cp.

PROVIDENCE, R. I.—Bids will be received at the office of the supervising architect, Washington, D. C., until June 10 for the installation of an electric passenger elevator in the United States post office, court house and custom house at Providence, R. I., in accordance with plans and specifications, copies of which may be obtained at the above office. O. Wenderoth is supervising architect.

Middle Atlantic

ALBANY, N. Y.—Governor Sulzer has signed the bill appropriating $1,500,000 for reconstruction, decorating and equipment of the State Capitol; $18,000 for continuing the construction of the State Education Building; $90,000 for furnishing, equipping and decorating said building; $21,500 for a power house, coal pockets and conduits, and $60,000 for repairs, furnishings and equipment of Assembly Chamber.

BINGHAMTON, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, N. Y., until June 4 for reconstruction of the electric-lighting system at the Binghamton State Hospital at Binghamton. Drawings and specifications may be consulted and blank proposals obtained at the Binghamton State Hospital and at the office of the state architect, Capitol, Albany, where plans and specifications may be obtained. Lewis F. Bilcher is state architect.

CENTER VILLAGE, N. Y.—Preparations are being made by the Afton-Windsor Lt., Ht. & Pwr. Co. for the construction of a hydroelectric power plant and steam auxiliary plant at Center Village and two substations, one located at Windsor and the other at Afton. Contracts for work will probably be awarded within the next 30 days. The equipment will consist of two boilers of 200 hp each, a Corliss engine with a rating of from 250 to 300 hp, two waterwheels with rating of 250 hp each (a third wheel will be installed later), one 400-kva, three-phase, 60-cycle, 600-r.p.m. belt-driven generator, full switchboard equipment for one 75-kva, one 150-kva and one 155-kva generating unit, one 150-kva, one 35-kva and one 125-kva transformer, all 22,000 volts; overhead-line material for approximately 30 miles of transmission line, 45 poles to mile (30-ft. cedar or chestnut poles will be used); about 400 meters will be required, not yet selected; 160 incandescent lamps, with bracket fixtures, etc., will be used for street-lighting. C. F. Wright, of Susquehanna, Pa., is president, and W. E. Bennett, of Lanesboro, vice-president and general manager.

HENDERSON, N. Y.—The Public Service Commission has granted George N. Wilson, of Rome, permission to exercise a franchise for furnishing electricity in the village of Henderson, Henderson Harbor and the town of Henderson. He proposes to utilize the water-power of Stony Creek to generate electricity, which will be supplemented by a steam plant for use during the low-water periods.

PENN YAN, N. Y.—The Board of Commissioners of the Municipal Electric Light Plant has decided to discard the flat-rate system and install meters. Business houses will be required to install meters before Aug. 1, and private residences as soon after as the board can provide the meters.

PITTSFORD, N. Y.—The village of Pittsford has contracted with the Despatch Ht., Lt. & Pwr. Co., of East Rochester, for lighting the streets of the village for a period of five years. The contract provides for 57 Mazda lamps ranging from 40 cp to 200 cp.

ROCHESTER, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, N. Y., until June 11, for construction of nurses' home, including heating, plumbing and electric work, at the Rochester State Hospital, Rochester, N. Y. Bids will be received for each division of the work separately; no combination of bids will be considered. Drawings and specifications may be consulted and blank forms of proposal obtained at the Rochester State Hospital, Rochester, and at the office of the state architect, Capitol, Albany. Complete set of plans and specifications will be furnished upon application to Lewis F. Pilcher, state architect, Capitol, Albany. T. E. McGarr is secretary of State Hospital Commission.

SYRACUSE, N. Y.—The Syracuse Ltg. Co. has applied to the Public Service Commission for permission to issue $81,000 of its extension and improvement bonds. The company proposes to purchase a 5000-kw turbo-generator unit.

WATERLOO, N. Y.—Plans are being considered for the installation of an ornamental street-lighting system and an all-night lighting service for this village. It is proposed to replace the present arc lamps with the 80-cp Mazda lamps (clustered) and to substitute 40-cp Mazda lamps for the present 30-cp lamps and also to erect ornamental lamp standards, carrying five-lamp clusters, on Main Street between Locust and Church Streets, on Virginia Street, from the bridge to William Street, and possibly in the village park.

WATERTOWN, N. Y.—A new electric-power company, capitalized at $1,000,000, has applied to the Secretary of State for permission to incorporate. Electricity generated by the Beaver River plant and others in Jefferson and Lewis Counties will be distributed over a wide territory in northern New York. Several undeveloped plants will be utilized in the extension of the service. George Babcock, H. G. Davis, J. B. Taylor, S. L. George, O. A. Kline, F. A. Rogers and C. C. Burns are the incorporators.

WEST SENECA, N. Y.—Bids will be received at the office of the town clerk, West Seneca, until May 28 for furnishing 306 series incandescent tungsten lamps in lighting district No. 1 in the town of West Seneca, according to plans and specifications on file in the office of the town clerk. Bidders will be required to give a price per lamp per year for each of the following: For 60-cp lamps, 80-cp lamps and 100-cp lamps. West Seneca has not a post office.

ALTOONA, PA.—The Penn Central Lt. & Pwr. Co. has entered into a contract to furnish electricity to the Jackson Lt., Ht. & Pwr. Co., which furnishes electrical service in Nant-y-Glo. The Springfield Coal Co., of Nant-y-Glo, has contracted with the Penn company for electrical service. A substation will be erected here by the power company.

JERSEY SHORE, PA.—The Pennsylvania Keystone El. Co., recently granted a charter by Governor Tener, will again ask for a franchise to furnish electricity for lamps and motors in Jersey Shore. The company proposes to build an electric power plant in Antes Gap to be operated by water-power in conjunction with the large paint mill. It also proposes to extend its transmission to other adjoining towns to furnish electrical service, and it is said that a line will eventually be extended to Williamsport.

PHILADELPHIA, PA.—Shaughnessy & Wiler have been awarded the contract for remodeling the interior of the power plant of Nathan C. Lane at 410-412 Cherry Street, Philadelphia.

JERSEY CITY, N. J.—The Board of Freeholders is considering a plan to light the county roads, parks and public institutions from the electric plant in the new court house.

NEWARK, N. J.—Bids will be received by the Board of Education, Newark, until May 27 for regular and special lighting fixtures for the Newton Avenue School, plans and specifications for which are on file at the construction department of the board. R. D. Argue is secretary.

SOUTH AMBOY, N. J.—The Borough Council has opened negotiations with the Jersey Central Trac. Co. for placing its overhead wires on Stevens Avenue in underground conduits.

WILMINGTON, DEL.—Bids will be received by the Board of Public Education, Wilmington, Del., until May 26, for electric-lighting fixtures for the Evans G. Shortlidge Schoolhouse. Bidders must submit samples for ceiling lamps and wall brackets. Further information may be obtained from E. L. Rice., Jr., Co., architect. H. J. Guthrie is secretary.

OCEAN CITY, MD.—Application has been made to the Public Service Commission by Henry T. Moore, of Wilmington, Del., president of the Delmarvia Utilities Co., for permission to establish an electric-light plant in Ocean City. The company has secured the franchise recently granted to John W. Brawner, of Washington.

COVINGTON, VA.—The Virginia Western Electrical Co., of Clifton Forge, which recently purchased the property of the Covington Lt. & Pwr. Co., has been granted a 30-year franchise by the Town Council. Under the terms of the franchise the town has the privilege of purchasing the plant and canceling the contract at any time. G. G. Matthews is president and A. C. Ford secretary and treasurer, both of Clifton Forge.

COVINGTON, VA.—Application has been made by O. C. Barber, L. M. Latta, of Akron, Ohio, and T. M. Gathright, of Covington, Va., for a charter for the Falling Springs Marl Co. The Falling Springs property, including the falls, has been purchased by them and the water-power is being developed for generating electrical energy. The present plans provide for the development of about 400 hp and the construction of an electric railway from the quarry to the railroad.

WINCHESTER, VA.—The Virginia Corporation Commission has granted the Winchester & Washington City Ry. Co. permission to change

its name to the Northern Virginia Pwr. Co. The company does not intend to engage in the railway business, but will confine its efforts to furnishing electricity for municipal, manufacturing and commercial purposes. The electric railway to be built from Bluemont, Va., through Berryville, Winchester, Williamsport and Hagerstown will secure power from the plants of the Northern Virginia Pwr. Co.

WASHINGTON, D. C.—Bids will be received at the Engineer Depot, United States Army, Washington Barracks, D. C., until May 27 for furnishing cambric-insulated cable. For further information address Major W. J. Harden.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until June 2 for furnishing two carloads of bituminized fiber conduit (approximately 25,000 ft. to carload), as per specification 238-D, and 100 gal. jointing compound for 3-in. fiber conduit (extra) to be furnished in 1-gal. cans. Major W. L. Clarke is disbursing officer.

WASHINGTON, D. C.—Bids will be received until June 7 at the office of the chief signal officer, War Department, Washington, D. C., for furnishing wire and cable as follows: (1) For 20,000 ft. rubber-covered and braided, 51 mils, copper wire, N. E. code standard for 600 volts; (2) 30,000 ft. pothead, 36 mils, wire; (3) 10,000 ft. twisted pair bridle, 51 mils, wire; (4) 5000 ft. single bridle, 51 mils, wire; (5) 50 miles galvanized, 81 mils, iron wire; (6) 85,000 ft. house, 36 mils, wire; (7) 10,000 ft. cable, type 413; (8) 3000 ft. cable, type 418; (9) 10,000 ft. cable, type No. 411; (10) 5000 ft. cable, type 417; (11) 50 miles galvanized, 144 mils, iron wire; (12) 10,000 ft. cable, type 213; (13) 35,000 ft. cable, type 321; (14) 6000 ft. cable, type 324; (15) 18,000 ft. cable, type 327; (16) 10,000 ft. cable, type 401; (17) 6000 ft. cable, type 403; (18) 10,000 ft. cable, type 407; (19) 3000 ft. cable, type 408; (20) 10,000 ft. cable, type 409; (21) 1000 ft. cable, type 624; (22) 1000 ft. cable, type 644; (23) 5000 ft. cable, type 325. Reels are to remain the property of the contractor to be returned by the government when empty. Major W. L. Clarke is chief signal officer.

North Central

DETROIT, MICH.—The Ford Motor Co., it is reported, will add another unit to its power plant to furnish power to the large addition to its works which will soon be erected., Edward Gray is engineer.

DETROIT, MICH.—The Paige-Detroit Motor Car Co. is planning to erect a factory building on McKinstry Avenue. A separate building will be erected for power plant. John Scott & Co. are architects.

INGALLS, MICH.—Work will begin as soon as possible on rebuilding the dam, owned by Ira Carley, which was recently washed away, carrying with it a dynamo and two waterwheels. A new generator and two waterwheels will be purchased to replace those carried into the river.

MARQUETTE, MICH.—The Light and Power Commission has decided to build a spillway at Silver Lake, where storage water for the Dead River power plant is dammed. The commission has also voted to furnish the Marquette City & Presque Isle Ry. Co. with electricity to operate its street-railway system. The company will place orders at once for a 200-kw rotary converter and two 100-kw transformers for its power plant. Charles Retallic is manager of the street-railway company and also of the municipal electric-light plant.

MENOMINEE, MICH.—Funds are being solicited for the installation of an ornamental street-lighting system. It is proposed to erect ornamental standards, carrying five-lamp clusters, manufactured by the Prescott Co., of Menominee.

NEWBERRY, MICH.—Plans are being prepared by Charlton & Kuensli, architects, for the construction of various buildings for the Newberry State Hospital, for which $85,000 was appropriated by the State Legislature. Considerable new machinery will be installed in the power plant.

ST. CHARLES, MICH.—The city of St. Charles contemplates the purchase of a series Mazda street-lighting system, consisting of about 150 lamps, within the next 12 months. L. V. Troup is superintendent.

WHITEHALL, MICH.—The Frugale Co. is erecting a power plant to furnish light to the summer-resort districts.

MARIETTA, OHIO.—Preparations are being made by the Parkersburg, Marietta & Interurban Ry. Co. to begin work in the near future on the construction of dams and hydroelectric power plants along the Muskingum River in Ohio to furnish electricity to the Muskingum, Little Kanawha district and a great part of the Ohio Valley. Henry N. Archer, of Parkersburg, is general manager.

AUBURN, KY.—The owners of the Auburn Mills are contemplating the installation of an electric-light plant to furnish electricity for lighting the town and would like to communicate with manufacturers of electrical equipment and contractors in regard to same. Charles E. Bates is manager.

PADUCAH, KY.—The City Council is considering the purchase of an additional engine in the municipal electric-light plant and the installation of a generator and motors to operate the pumps which are to be located at the water-works station. Frank Burns is chairman of the public improvement committee of the Council.

BLOOMINGTON, IND.—The Southern Indiana Pwr. Co., of Bedford, will erect a transmission line from its power plant in Williams to Bloomington, to furnish electricity for the large quarries, etc. Switching equipment and 2500 kva in transformers will be distributed and installed between three stations: 21 miles No. 3 wire and 500 steel towers will be required for the transmission line. D. J. Angus is superintendent.

BRAZIL, IND.—The Brazil El. Co., it is reported, will close down its power plant and secure electricity from the Terre Haute, Indianapolis & Eastern Trac. Co. to operate its system.

CLAYTON, IND.—Arrangements are being made for the installation of an electric-lighting system in Clayton. Electricity for operating the proposed system will be furnished by the Danville Lt., Ht. & Pwr. Co., of Danville. A transmission line about 5 miles in length will be erected to furnish the service. The street-lighting system will consist of about 40 arc lamps. Bids for construction of system will be asked about July 1. The Foxworthy El. Co., of Indianapolis, has charge of the engineering work.

FORT WAYNE, IND.—The Wabash Valley Utilities Co., of Fort Wayne, has purchased the holdings of the Kehoe Lt. & Pwr. Co., of Fort Wayne, which furnishes electricity for lamps in the cities of New Haven, Ossian, Rockfield, Flora and Camden, Ind.

HILLSBORO, IND.—A movement has been started by citizens of Hillsboro and farmers near here to organize a telephone company with a capital stock of $12,000.

WINGATE, IND.—The installation of an electric-light system in Wingate is contemplated. Electricity for operating the system will probably be secured from Crawfordsville. The erection of transmission lines from Crawfordsville to furnish electrical energy in Linden, New Richmond and Waynetown is contemplated.

ALEDO, ILL.—The Tri-County Lt. & Pwr. Co. has closed contracts to furnish electricity to operate the plants of the Aledo Brick & Tile Works and the T. D. Winders Cold Storage Co.

ALTON, ILL.—We are informed that the city of Alton does not contemplate the installation of flaming-arc lamps, as reported in the issue of May 10. An ornamental street-lighting system has already been installed. B. R. Kennedy is city clerk.

BLOOMINGTON, ILL.—Arrangements are being made to install one 200-kw Fort Wayne generator, one 250-hp Hamilton Corliss engine, switchboard and instruments in the municipal electric-light plant within the next month. The city of Bloomington expects to purchase within the next 12 months one 500-hp water-tube boiler with mechanical stokers for the municipal plant. S. S. Noble is superintendent.

BUCKLEY, ILL.—It is reported that an agreement has been reached between the Village Board and the Central Illinois Utilities Co., whereby the village has sold the municipal electric-light plant to the company for $4,750. The company is to be given a franchise and also a contract to pump water for the municipal water-works system.

CARLINVILLE, ILL.—The Madison County Lt. & Pwr. Co. is reconstructing both its power house and transmission line in Carlinville. The equipment will consist of one 190-kw direct-connected unit, consisting of an Erie simple engine and a Westinghouse 2300-volt alternator. A 60-kw motor generator set to receive current at 33,000 volts will be installed for auxiliary purposes. No changes will be made in the boiler equipment at this time. New switchboard equipment will be installed for the 190-kw unit and 60-cycle motor generator, together with one distributing panel and one panel for operation of the street-lighting system, to be selected later. The distributing system will be rebuilt for 2300-volt, 60-cycle current (poles used). All material has been purchased with the exception of the street-lighting system, which has not yet been decided upon, the decision resting with the City Council. C. T. Wheat is local superintendent and E. D. Bell, of St. Louis, Mo., is general superintendent.

DECATUR, ILL.—The Wabash R. R. Co. contemplates the installation of a telephone system on the Springfield division between Montpelier and Chicago. J. P. Church, of Decatur, is superintendent of telegraph.

ELGIN, ILL.—A petition which will be presented to the Board of Local Improvements is being circulated on North Liberty Street for the installation of an ornamental street-lighting system. Petitions are being circulated for ornamental lamps on Lindon and Forest Avenues and on Lily and Park Avenues between North Liberty Street and Lords Park. Conrad Ackerman, 582 Park Street, Elgin, is interested.

ELLIOTT, ILL.—The Village Board has granted the Central Illinois Utilities Co., of Piper City, a franchise to construct and operate an electric-light system here. The company has been given a ten-year contract for street lighting.

FREEPORT, ILL.—The Board of Park Commissioners is contemplating installing a lighting system in Taylor Park.

GLASFORD, ILL.—The Canton Gas & El. Co. has applied to the Village Board for a franchise to furnish electricity for lamps and motors in Glasford.

GRIDLEY, ILL.—The Village Board has closed a contract with the Illinois Traction System for lighting the streets of the village.

LEWISTOWN, ILL.—The Lewistown El. Co. has submitted a proposition to the City Council, asking for a new contract for street-lighting and that tungsten lamps be substituted for the arc lamps now in use. The company also offers to furnish electricity for pumping the city water for $200 per month and 10 cents per 1000 gal. for all over that amount.

PEORIA, ILL.—City Electrician Wolgamott has recommended to the

City Council that the wires of the fire and police alarm system be placed underground and the system extended.

PIPER CITY, ILL.—The Village Board has granted the Central Illinois Utilities Co., of Piper City, a new 30-year franchise.

QUINCY, ILL.—The Quincy Gas, El. & Htg. Co. has completed the cable installation on its underground circuit and expects to begin changing over the overhead lines immediately. It will also make the necessary changes in its plant to utilize power from the Cooper Dam, which will require the installation of frequency changers and some large transformers as well as a switchboard. The company will continue to distribute 60-cycle current for lighting purposes, the hydroelectric current being 25 cycles. H. O. Channon is manager.

SHEFFIELD, ILL.—The American Gas Co., of Philadelphia, Pa., has purchased the property of the Sheffield El. Lt. Co. A number of improvements will be made to the plant and the service will be extended. It is expected within a few months that electricity will be transmitted from Kewanee to Sheffield, when a 24-hour service will be established.

SPRINGFIELD, ILL.—City Electrician Fred Spers has recommended to the City Commission the installation of an improved system of police and fire alarm signals.

STERLING, ILL.—The Rock River Lt. & Pwr. Co., of Sterling, has authorized H. H. Green, general manager, to negotiate for franchises and street-lighting contracts in Sterling, Morrison, Tampico, Prophetstown, Erie, Lyndon, Fulton and Albany. The company was recently incorporated with a capital stock of $300,000 by H. H. Wood, Edwin F. Lawrence and H. S. Green.

TIMEWELL, ILL.—The Village Board has granted the Central Illinois Public Ser. Co., of Mattoon, a franchise to furnish electricity in Timewell.

VERSAILLES, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, has been granted a franchise by the Village Board to furnish electricity in Versailles.

WILLIAMSVILLE, ILL.—The Illinois Traction System contemplates installing an electric distributing system in Williamsville and is trying to secure a contract for lighting the streets here.

YORKVILLE, ILL.—The Village Board has granted the Public Service Co. of Northern Illinois, of Chicago, a franchise to furnish electricity for lamps and motors in Yorkville.

MADISON, WIS.—Plans are being considered by the State Street Improvement Association for the installation of an ornamental street-lighting system, to consist of 90 ornamental lamp standards carrying five-lamp clusters (one 100-watt and four 60-watt lamps), maintained by underground wires; fiber-conduit, lead-covered, three-wire cable will be used. The cost of the standards is estimated at $4,000 and construction, erection, etc., at about $5,000. The association would like to correspond with concerns furnishing any or all the material in connection with street-lighting installations. F. W. Huels, 115 State Street, Madison, is chairman of lighting committee.

MILWAUKEE, WIS.—The Milwaukee El. Ry. & Lt. Co. is testing a new arc lamp and, if satisfactory, expects to install several hundred.

MILWAUKEE, WIS.—The Commonwealth Pwr. Co. has applied to the City Council for an extension of its franchise rights in the downtown district.

ALBERT LEA, MINN.—The Minnesota Gas & El. Co. is erecting a new power house and is installing three 400-hp Heine boilers and superheaters, Detroit stokers, two 500-kw and one 300-kw Westinghouse turbine, one 300-kw and one 200-kw Westinghouse rotary converter, coal and ash conveyor, exciters, pumps, etc., and is rebuilding its distributing system and street-lighting system. Ludwig Kemper is treasurer.

BIG FALLS, MINN.—The Big Falls Mfg. Co. expects to erect within the next three months a power plant and distributing system for lighting the town of Big Falls, for which material has already been purchased. The company expects to purchase within the next three or four months miscellaneous electrical appliances and supplies. A. L. Shipley is manager.

BUFFALO, MINN.—The town of Buffalo contemplates securing electricity from the plant of the Bisbee Company as soon as its dam on the Mississippi is completed. H. H. Chilson is superintendent.

DETROIT, MINN.—The city of Detroit expects to install an ornamental street-lighting system, covering a distance of about ½ mile. E. J. Bestick is purchasing agent.

FARMINGTON, MINN.—The Farmington El. Lt. & Pwr. Co. expects to purchase within the next 12 months a 60-kw generator, either a 6600-volt alternating-current, a 220-volt direct-current, or a combined machine, with switchboard for same; either an oil engine, a producer-gas engine or a steam engine with a rating of about 80 hp, and various electrical appliances, including vacuum cleaners, flatirons, toasters, etc. The company has recently purchased a 240-amp storage-battery booster, switchboard, etc., and will establish a 24-hour service as soon as installed. F. H. Eddy is manager.

FULDA, MINN.—The power plant of the Fulda Lt. & Pwr. Co., which was recently damaged by fire, has been repaired and is now in operation. The company contemplates extending its transmission line to Dundee and Kinbrae in the near future to furnish electricity to both of those towns for lamps and motors. F. D. Lindquist is secretary.

KENYON, MINN.—M. G. Gunderson, proprietor of the local electric-light plant, contemplates the purchase of about 100 incandescent lamps for street-lighting purposes.

LAKE CITY, MINN.—The city of Lake City expects to build within the next six months a 500,000-gal. reinforced concrete reservoir and about 2 miles of 12-in. pipe line, to cost about $30,000. Within the next year the city expects to purchase two new arc panels for switchboard, having a capacity of 75 arc lamps each; also to purchase within the next three months two or three 10-kva transformers and lightning arrestors for same. M. J. Howe is superintendent.

LYLE, MINN.—The installation of an oil engine is contemplated by the owners of the local electric-light plant; also the purchase of incandescent lamps within the next three months. N. T. Fortun is manager.

MADISON, MINN.—The managers of the municipal electric-light plant contemplate taking steps to advocate the installation of small electric motors and the use of electrical heating devices and expect to purchase some electric fans. J. C. Bang is superintendent.

MONTEVIDEO, MINN.—Plans have been prepared by the Montevideo El. Lt. & Pwr. Co. for the construction of a new power house, 136 ft. by 40 ft. on the site of the present power plant, to cost about $40,000. The new building will provide space for the steam plant and fixtures and also for office room.

ST. PAUL, MINN.—Bids will be received at the office of the Ramsay County Board of Control, Room 15, Court House and City Hall, St. Paul, until May 29, for plumbing, heating, electric work and electric elevator for the pavilion of the tuberculosis patients at the City and County Hospital, in accordance with plans and specifications prepared by Clarence H. Johnston, architect, which are on file in the office of the board. Daniel Kelly is chairman of board.

THIEF RIVER FALLS, MINN.—The city of Thief River Falls expects to install within the next two months an ornamental street-lighting system, consisting of 24 ornamental lamp standards carrying tungsten lamps, and to purchase 24 pole lightning arresters. Leonard Peterson is superintendent.

CEDAR RAPIDS, IA.—An agreement has been entered into between the city of Cedar Rapids and the Iowa Ry. & Lt. Co. whereby a dam will be built across the Cedar River at Cedar Falls and leased to the Iowa Ry. & Lt. Co. for a period of 24 years. Louis Roth is Mayor.

CEDAR RAPIDS, IA.—A report has been submitted to the City Council by Ira Grant Hedrick, consulting engineer, 1118 McGee Street, Kansas City, Mo., stating that the city can build an 8-ft. dam near the present dam and build and equip a power house to develop 400 hp for $200,000.

CHARLES CITY, IA.—The local electric-light and heating plant and water-works system have been purchased by H. H. Caughlan, of Waterloo; M. A. Harrison, of Nevada, and A. L. Dodd, of Mason City.

CLINTON, IA.—The Clinton Gas & El. Co. expects to increase the output of its plant and will install a 2000-kw generating unit, together with turbines, boilers, etc., switches, switchboard, transformers and other auxiliary apparatus, and will also erect about 18 miles of transmission line. Thomas Crawford is general manager.

DOW CITY, IA.—Improvements are contemplated to the municipal electric-light plant, including the installation of one 17½-kw, three-wire, 2200-volt dynamo and one 25-hp gas engine, and will probably erect about 2 miles of transmission line within the next three months. The purchase of eight lightning arresters, one carload of poles and from 30 to 40 direct-current meters is contemplated, and also the purchase of from 25 to 50 electric irons and material for wiring from 30 to 40 houses within the next three months. A. E. Loring is operating engineer and electrician.

MENLO, IA.—George C. Buckley & Co., owners of the local electric-light plant, are contemplating increasing the output of their plant. George C. Buckley is president and manager.

MONONA, IA.—The proposition to grant a franchise to Wellman & Sons to install and operate an electric-light plant in Monona will be submitted to the voters on May 27.

MONTROSE, IA. — Plans are being considered for the installation of an electric-lighting plant in Montrose. G. Vandyke is interested in the project.

MOUNT AYR, IA.—The Mount Ayr Lt. & Pwr. Co. expects to purchase within the next six months one 100-kw, 220-volt direct-current generator, one 125-hp engine and a 125-hp boiler. R. M. Lewis is manager.

PANORA, IA.—A special election will soon be held to vote on the proposition to purchase the electric plant of the Panora El. Lt. & Pwr. Co., to be owned and operated by the municipality.

SIOUX CITY, IA.—The Sioux City Ser. Co. contemplates installing new generators to double the present capacity of the plant.

CHAFFEE, MO.—Application has been made to the Missouri Public Service Commission by J. J. Astor, of Chaffee, for permission to sell his franchise and electric-light plant to the Missouri Public Utilities Co., of St. Louis.

FULTON, MO.—Bids will be received by the managers of the Missouri School for the Deaf, Fulton, until June 9 for construction of power house, 97 ft. by 98 ft., and brick smokestack. Plans and specifications are on file at the institution and at the office of M. F. Bell, of Fulton, architect.

MARYVILLE, MO.—Bids will be received by the Board of Public Works of Maryville, at the office of F. L. Flynt, superintendent of construction, until June 2, for the following equipment: For one high-service compound condensing duplex direct-acting pump of 1,000,000-gal capacity; two low-service horizontal split-case centrifugal pumps (directly connected to steam engine) of 1000 gal. per minute capacity each; one boiler-feed pump; two pressure filters of 250,000 gal. capacity each; one 4-kw, 120-volt, direct-current generator directly connected to steam engine; one 150-hp open feed-water heater and low concrete dam, gravity section. Plans and specifications are on file at the office of the superintendent of construction, Maryville, and also at the office of Hiram Phillips, consulting engineer, St. Louis, Mo. Copies of specifications will be furnished upon application to F. L. Flynt, superintendent of construction.

OREGON, MO.—Preparations are being made for the installation of a 60-hp oil engine in the municipal electric-light plant. When improvements are completed a 24-hour service will be established.

PORTAGEVILLE, MO.—The Portageville Stave Co. is contemplating the construction of a stave mill, electric-light and ice plants in the near future. N. V. Turner and J. B. Drerup are interested in the project.

KENMARE, N. D.—The installation of an ornamental street-lighting system is contemplated by business men. Mayor Cole is interested in the project.

VELVA, N. D.—Preparations are being made by O. J. Kauffman, of Hillsboro, Wis., for the construction of an electric-light plant in Velva. Mr. Kauffman is open for bids for the following equipment: One 16-ft. by 60-in. return-flue boiler, one 14-in. by 30-in. Corliss engine, one 60-kw, three-phase, 60-cycle, 2200-volt generator, complete switchboard equipment, one 120-kw constant-current transformer for series street-lighting system, 100 meters and 2000 tungsten lamps. Cedar poles and 5 miles of No. 6 and 3 miles of No. 10 weatherproof wire will be required for overhead distributing system. Contracts will be awarded between June 1 and 15.

HUDSON, S. D.—Steps have been taken toward organizing a company to install an electric-light plant in Hudson. J. B. Bradley is interested.

BENEDICT, NEB.—The town of Benedict is planning to rebuild the entire lighting system and expects to purchase 75 25-ft. (5-in.-top) poles. O. B. Canfield is manager of the municipal electric-light plant.

COOK, NEB.—Bonds to the amount of $5,000 for the installation of an electric-lighting system have been voted.

SIDNEY, NEB.—The City Council has called a special election to be held in June to vote on the proposition of issuing $22,000 in bonds for the purpose of installing an electric-light plant with sufficient power to pump the city water.

WISNER, NEB.—Arrangements are being made to change the system of the municipal electric-light plant from direct current to alternating current. Bids will be called within the next ten days for the following equipment: One 75-kw, three-phase, 60-cycle, 2200-220-110-volt generator, one 3-kw, 125-volt exciter, one 30-hp, three-phase, 2200-volt belted motor, one remote-control regulator with main-line switch for 30-hp motor, one three-panel switchboard with instruments, switches and other protective devices; also transformers, lightning arresters, wire and other line material (no poles), series street-lighting regulator and hoods for street lamps. Paul Smith is superintendent of light and water department.

LARNED, KAN.—The property of the C. W. Smith El. & Ice Co., of Larned, has been purchased by a group of Newton capitalists for $110,000. It is stated that the new company may establish a power plant here for the proposed Arkansas Valley interurban railway west from Hutchinson.

MADISON, KAN.—Bids will be received until May 29 for construction of a combined municipal electric-light plant and water-works system. Rollins & Westover, Midland Building, Kansas City, Mo., are consulting engineers.

TESCOTT, KAN.—An election will soon be called to vote on the proposition to issue $25,00 in bonds for the construction of an electric-light system. Rollins & Westover, Midland Building, Kansas City, Mo., are engineers.

Southern States

CHERRYVILLE, N. C.—At an election held recently the proposition to issue $25,000 in bonds for an electric-light plant was defeated. The city will submit the proposition to the voters again in 12 months. E. C. Sharp is city clerk.

SPENCER, N. C.—At an election held recently the proposition to issue $50,000 in bonds to install an electric-light plant and water-works system was carried.

WASHINGTON, N. C.—At an election held recently the proposition to issue $20,000 in bonds for extensions to the municipal electric-light plant was carried.

JONESVILLE, S. C.—The question of issuing $22,000 in bonds for the installation of an electric-light plant and water-works system is under consideration. John T. Scott is Mayor.

WALTERBORO, S. C.—The Walterboro Ice & Lt. Co. has been granted a 25-year franchise to operate an electric-light plant in Walterboro. Work will begin on the installation of the power plant about October, 1913. As yet nothing definite has been decided upon.

BUFORD, GA.—The power house of the Georgia Ry. & El. Co. in Buford was completely destroyed by fire recently, leaving the city without electrical service. Work will begin on rebuilding the station immediately.

MACON, GA.—The Central Georgia Pwr. Co., of Macon, has purchased material for 2 miles of 6600-volt transmission lines around Macon and for a 11,000-volt transmission line to Hampton, 12 miles long. L. C. Magraw is chief engineer.

McDONOUGH, GA.—J. G. Smith, owner of the local electric-light plant, expects to purchase an arc-lamp circuit for lighting the streets of the city within the next two months and may also purchase a small direct-connected unit for day service, either turbine or reciprocating engine, and a three-phase, 2300-volt generator, with necessary switchboard equipment, etc., within the next two months. He may possibly purchase also a small rectifier for battery charging.

VALDOSTA, GA.—The Valdosta Ltg. Co. has just completed the installation of a new 500-hp Casey-Hedges boiler and a 650-kva Westinghouse-Parsons turbine and Wheeler condenser and has nearly finished rebuilding its distributing system. W. G. Eager is general manager.

LABELLE, FLA.—E. E. Goodno, owner of the local electric-light plant and ice plant, contemplates doubling the output of his plant this year. The present output of the electric plant maintains 1000 lamps and the ice plant has a daily capacity of 10 tons.

SARASOTA, FLA.—The Sarasota Ice & El. Co. contemplates increasing the output of its electric-light plant and is said to be asking for bids on 200-hp equipment. R. E. Ludwig is manager.

TARPON SPRINGS, FLA.—The Southern Utilities Co., Heard National Bank Building, Jacksonville, which recently purchased the property of the Polar Ice & Lt. Co., in Tarpon Springs, contemplates improvements to the plant, including the installation of additional machinery. H. C. Adams is general manager.

ALICEVILLE, ALA.—The Aliceville El. Co. is planning to install an electric-light plant here, to cost about $8,000. The company has already secured a franchise.

GREENVILLE, ALA.—The Henderson Lt. & Pwr. Co. has recently installed a 20-ton ice plant to be operated in connection with its electric-light plant. C. C. Henderson is president and manager.

MOBILE, ALA.—The Gressner & Groh El. Welding Co. contemplates installation of an electric-power plant (to cost about $5,000) in connection with an electric-welding plant for repairing steamship boilers and steel plate.

OPELIKA, ALA.—The city of Opelika expects to purchase within the next six months one 225-hp engine and a 150-kw generator for the municipal electric-light plant. Charles Shaefer is superintendent of the light and water department.

ROANOKE, ALA.—At an election held recently the proposition to issue $20,000 in bonds to rebuild the municipal electric-light plant and water-works system was carried.

SYLACAUGA, ALA.—The town of Sylacauga expects to purchase within the next few months a new street-lighting outfit, consisting of from 25 to 30 series Mazda street lamps. L. D. Coker is superintendent.

BOONEVILLE, MISS.—The Booneville Wtr. Wks. Co. has taken over the electric plant of the Citizens' El. & Tel. Co. and is rebuilding the same. The company is in the market for a 50-kw, three-phase 60-cycle, 2300-volt generator with exciter and switchboard with instruments; also lamps and line material, including wire, insulators, pole steps, etc., and electrical supplies; electric and water meters. Also motor-driven pumps and a constant-current transformer for street-lighting circuit. When improvements are completed a 24-hour service will be established. A. W. Kearley is president and general manager.

PORT GIBSON, MISS.—The city of Port Gibson expects to purchase within the next two months one 150-hp water-tube boiler for the municipal electric-light plant. H. D. Brownlee is superintendent.

GREEN FOREST, ARK.—The Green Forest Milling & Elevator Co. contemplates the installation of an electric-light plant to furnish electricity for lighting the town. J. Villines is president.

HUNTINGTON, ARK.—The Coal & Gas Belt El. Co., of Huntington, expects to purchase within the next 30 days an extra panel for switchboard and 25 100-watt Mazda series lamps for street-lighting system, and within the next three months one carload of 25-ft., 30-ft. and 25-ft. (6-in. top) cedar poles, 100,000 ft. of No. 6 bare copper wire and high-tension transformers rated at 225 kw. L. E. Lake is secretary and manager.

MENA, ARK.—The Mena El. Lt. & Pwr. Co. expects to install within the next two months a series Mazda-lamp street-lighting system and controller for same.

CLARKSVILLE, LA.—The Clarksville El. Lt. & Pwr. Co. is changing the street-lighting system from arc lamps to tungsten lamps. The arc lamps are for sale. A. D. VanMeter is manager.

RAYNE, LA.—Improvements are contemplated to the municipal electric-light plant and water-works system involving an expenditure of about $15,000.

INGERSOLL, OKLA.—Bonds to the amount of $5,000 have been

voted, the proceeds to be used to erect a transmission line to connect the local municipal electric plant with the municipal electric system in Cherokee, 3¾ miles distant. B. F. Blue is town clerk.

PENIEL, TEX.—Arrangements are being made for the installation of an electric-lighting system in Peniel. Electricity for operating the system will be secured from the Greenville municipal electric plant.

Pacific States

COLVILLE, WASH.—The Stevens County Pwr. & Lt. Co., of Colville, will extend its transmission lines from Colville to mines near Chewelah. Substations will be erected at Colville and 4 miles northeast of Chewelah. The equipment will consist of four 250-kw General Electric transformers. The overhead transmission lines will require 75 miles of No. 6 copper wire and 40-ft. cedar poles. H. R. Williams, of Colville, is engineer in charge of the work. Paul La Plant has charge of the line construction.

NEWPORT, WASH.—Plans are being considered for the construction of a large hydroelectric power plant on the Pend Oreille River at Newport. Application has been made by Wilbur S. Yearsley, of the Ham, Yearsley & Ryrie Co., of Spokane, to the State Land Board, asking that the board fix the value of the riparian lands along the Pend Oreille River for a distance of about 20 miles above Newport, which territory will be included in the power plant district.

PUGET SOUND, WASH.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 21 for electric traveling cranes for the general foundry, navy yard, Puget Sound. The cost of the work is estimated at $19,000. Plans and specifications may be obtained upon application to the bureau. William M. Smith is acting chief of bureau.

SPOKANE, WASH.—The Washington Wtr. Pwr. Co., of Spokane, is making preparations to extend its transmission lines to St. John, Lattah, Elberton, Spangle, Diamond and Sunset. Applications have been made by the company for franchises in the towns of Endicott, Creston, Wilbur, Almira and Hartline, which will probably be granted.

TACOMA, WASH.—The City Council has instructed B. W. Collins, superintendent of lighting, to proceed with the construction of the second pole line for high-tension wires from the municipal hydroelectric plant at La Grande, a distance of 30 miles.

ZILLAH, WASH.—The Northern Pacific Ry. Co. has instructed O. L. Hanson, of North Yakima, to make surveys for a high-line pumping ditch to irrigate lands in Yakima and Benton Counties. Power will be developed along the proposed route.

ASTORIA, ORE.—The Pacific Pwr. & Lt. Co., of Astoria, has applied to the County Court for permission to erect transmission lines along the county road for the purpose of extending its light and power service to Warrenton, Hammond and to points along the beach as far as Gearhart Park. Construction work will begin during the present year.

BAKER, ORE.—The Board of City Commissioners has instructed Mayor Palmer to engage an engineer to prepare estimates and plans for the installation of a municipal electric-light plant.

FLORENCE, ORE.—The Florence El. Co. contemplates laying a cable across the river to furnish electricity in Glenada.

MEDFORD, ORE.—The Rogue River Pub. Ser. Corpn., successor to the Rogue River Canal Co., has contracted with the Portland Beaver Cement Co., recently organized, to furnish electricity to the amount of 2000 hp per month for a period of three years to operate the cement works. The consolidation of power sites between Grant's Pass and Rogue River is nearing completion. Irrigation rights for 56,000 acres near Grant's Pass have been secured from the State, and ditches are now being built. The present plans provide for the construction of power dams at Gold Hill, Savage Rapids and possibly Rocky Point; also to take over the Anent and Golden Drift dams as well as the Rogue River Chicago Irrigation Co. and put them under one operating head. Indiana capitalists headed by F. M. Fauvre and W. H. English, of Indianapolis, Ind., are interested in the project. The contract for construction of the cement plant has been awarded to the Leigh Hunt Engineering Co., of Kansas City, Mo., with an initial capacity of 1000 bbl.

PORTLAND, ORE.—Estimates have been submitted by J. H. Cunningham, consulting engineer, employed by Mayor Rushlight to make investigations as to the probable cost of a plant on the Clackamas River, giving the cost of the entire project at about $2,433,538. The plans provide for construction of a power plant on the Clackamas River about 12½ miles from Portland, with transmission lines to this city. It is estimated that the proposed plant would supply electricity for lighting the streets, public buildings and other municipal purposes, as well as a large amount for commercial purposes. Before definite action is taken on a municipal plant two other streams within easy reach of Portland will be investigated.

WARRINGTON, ORE.—The Pacific Pwr. & Lt. Co., of Portland, has petitioned the City Council for a 50-year franchise to furnish electricity in Warrington for lamps and motors. It is understood that this is part of the proposed plan of the company to extend its transmission line from Astoria to Gearhart, through Warrington, Hammond, Port Stevens, Klatsop and the Beach resorts.

ALAMEDA, CAL.—Extensive improvements are being made to the municipal electric-light plant, including the construction of a new power station (which is being erected over the old structure). A 1250-kva Westinghouse-Parsons turbine, 60-cycle, 2400-volt and a complete new General Electric switchboard with 14-feeder regulator are being installed. Two additional 300-hp Stirling boilers with new equipment of feed and auxiliary pumps, closed heater, deep-well pump, new fuel-oil set, with 2000-bbl. storage for fuel oil, also 1700 ft. of wharf covering salt-water intake pipe and oil line to channel for the delivery of oil in barges, have been installed. The installation of 4000 single-standard lamp-posts with 60-watt Mazda lamps throughout the city has been completed. Joseph B. Kahn is superintendent.

AUBURN, CAL.—Alexander Brothers, of Los Angeles, have acquired the Crandall Mine, near Auburn, and are planning to install electrically operated hoists, pumps, compressor and machine drills in the near future.

FRESNO, CAL.—The San Joaquin Lt. & Pwr. Co. is preparing to erect a 10,000-volt distributing line 10 miles long to supply the Barstow Colony with electricity for lamps and motors. The line will be extended from a point near Rolinda to the San Joaquin River. Laterals will be erected to individual consumers along the line.

LOS ANGELES, CAL.—The Board of Public Works will receive bids for furnishing structural steel for the Francisquito power plant No. 1. This is on the line of the aqueduct. Horace B. Ferris is secretary.

LOS ANGELES, CAL.—The City Council is considering an ordinance requiring ornamental street-lighting systems on Arlington Avenue from Pico Street to the Country Club, on Westchester Place between the same streets, and on the Country Club Drive from Westchester Place to Arlington Avenue. A similar ordinance will be passed authorizing ornamental lamps on Westmoreland Boulevard between Sixteenth Street and Washington Street.

OROVILLE, CAL.—The substation of the Pacific Gas & El. Co. in Oroville was destroyed by fire on May 12, causing a loss of about $25,000. Three 60,000-volt transformers were burned out.

RIVERSIDE, CAL.—The city of Riverside expects to erect a substation having a capacity of 750 kw in the Arlington section of the city within the next 30 days, and also to purchase a three-feeder panel complete for distributing circuits and material for 5 miles of underground conduits. The city also expects to purchase within the next three months 150 street lamp-posts. E. Cutting is superintendent.

SAN FRANCISCO, CAL.—Bids will be received at the office of the supervising architect, Washington, D. C., until June 9 for a conduit and wiring system in the United States Marine Hospital at San Francisco, in accordance with plans and specifications, copies of which may be had at the above office or at the office of the supervising superintendent of construction, United States post office, San Francisco. O. Wenderoth is supervising architect.

SAN JACINTO, CAL.—Antonio Domenigoni, of San Jacinto, has filed on 300 miners' inches of water in Tauquitz Creek, in the San Jacinto Mountains, for irrigation and power purposes.

SATTLEY, CAL.—The Mountain Devel. Co. is preparing to begin work on construction of a 3500-hp hydroelectric plant near Sattley. A 1385-ft. head will be secured and water will be supplied from a reservoir to be constructed in Wild Bill Canyon. Albert C. Agnew, of Oakland, is attorney for the company.

VISALIA, CAL.—The Pacific Lt. & Pwr. Corpn., of Los Angeles, has been granted a franchise to erect transmission lines across Tulare County from the Fresno County plants to southern California.

WOODLAND, CAL.—The Board of Supervisors has granted the Oro Lt. & Pwr. Co., of Oroville, a franchise to erect transmission lines over and under the highways in Yolo County, for which the company paid $1,000.

BELLEVUE, IDAHO.—The Rockwell-White Pwr. Co. expects to erect about 10 miles of high-tension transmission lines to the mining properties in Bullion and Mineral Hill mining district near Hailey and to purchase lightning arresters, meters and transformers within the next six months; also to purchase lamps, posts, etc., within the next three months. The Rockwell-White Co. has secured control of the hydroelectric plant of the Cramer El. Co. at Hailey, has closed down the Hailey plant and is operating all service connections from the central plant at Bellevue. Irvin E. Rockwell is president and M. B. Herron superintendent of the company.

EMMETT, IDAHO.—The City Council is considering the purchase of the local electric plant, owned by the Idaho-Oregon Lt. & Pwr. Co. The franchise held by the company expires in January, 1914.

GRANGEVILLE, IDAHO.—The Grangeville El. Lt. & Pwr. Co. expects to purchase within the next two months material for distribution system, consisting of 300 poles, 10,000 ft. of No. 6 wire, 1000 22,000-volt insulators, three 75-kw, 22,000-volt transformers and one set of lightning arresters. Eugene Enloe is president and manager.

LEWISTON, IDAHO.—The Lewiston Orchard Rural Tel. Co. will erect 19 miles of telephone line to serve the Lewiston Orchards.

OROFINO, IDAHO.—The Lewis County El. Co., of Orofino, has sold its holdings in this city, Peck, Kamiah and Nez Perce, and also its power sites on the Salmon River, Bolo Creek and at Orofino, to the Grangeville El. Lt. & Pwr. Co., of Grangeville. W. C. Sivyer, of Spokane, Wash., is vice-president of the new company.

POCATELLO, IDAHO.—The City Council has granted the Beaver

River Pwr. Co., of Bliss, a franchise to furnish electricity for lamps and motors in Pocatello.

COLORADO SPRINGS, COL.—The grand jury recently discharged by Judge Morris has recommended that steps be taken under the existing ordinance for rewiring immediately the following-named hotels and schools: Alta Vista Hotel, Elk Hotel, Glockner sanitarium tents, De Graff Building, McIntyre-Barnett Building, High School, Bristol School, Lincoln School and Lowell School. The city electrician is authorized to see that the work is carried out.

GLENWOOD SPRINGS, COL.—The Mutual Lt., Ht. & Pwr. Co. expects to erect a hydroelectric power plant and to purchase water turbines and generators, switchboard, etc., transformers, etc., and material for 3 miles of transmission line within the next six months. A. A. Haley is manager.

Canada

PRINCE RUPERT, B. C.—A by-law will soon be submitted to the ratepayers for the installation of a complete new distributing system.

BRANDON, MAN.—By-laws will be submitted to the ratepayers in the near future authorizing an expenditure of $26,618 for street-lighting equipment and $150,000 for street-railway extensions.

ENGLEHART, ONT.—The power plant of the Englehart-Charlton Pwr. Co. was destroyed by fire on May 4.

NORWOOD, ONT.—W. C. Harrison, owner of the local electric-light plant, contemplates the installation of an additional 50-kw or 60-kw generator within the present year.

PORT DOVER, ONT.—The ratepayers have recently approved a by-law authorizing the construction of a municipal electric-light plant, to cost $40,000.

MONTREAL, QUE.—Extensions contemplated by the Maritime Coal, Ry. & Pwr. Co., Ltd., include additions to the power plant at Chignecto and equipping the colliery at Joggins Mines for electrical operation.

QUEBEC, QUE.—The Dorchester El. Co. has been awarded the contract for lighting Battlefields Park. The contract calls for 78 standards, 34 carrying a single 250-cp tungsten lamp and 44 carrying tungsten lamps (clustered). All lamps will be maintained by underground wires.

ESTEVAN, SASK.—Plans are being considered for doubling the output of the municipal electric-light plant in the near future.

WEYBURN, SASK.—The town of Weyburn is installing two 266-hp water-tube boilers in the municipal electric-light plant. It is understood that a 500-kw steam-driven generating unit will be installed in the near future.

Miscellaneous

PEARL HARBOR, HAWAII.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 10 for furnishing the following supplies to the navy yard at Pearl Harbor, Hawaii: Schedule 5467—Two positive-pressure, motor-driven blowers, one motor-driven buffer and grinder, two motor-driven automatic gear cutter, one multiple-spindle, all-geared, motor-driven drill, four stationary head, belt and motor-driven drills, two upright, belt and motor-driven drills, one portable electrically driven bench grinder, two double dry, motor-driven grinders, three combination wet and dry, motor-driven grinders, two single, wet, motor-driven grinders, three 1-ton electric hoists for foundry use, two 2-ton and 4-ton electric hoists, one motor-driven buffing lathe, two motors, 50-hp and 15-hp, fitted with pulleys, one motor-driven crank-shaft lathe, four motor-driven speed lathes. Applications for proposals should designate the schedule desired by number. T. J. Cowie is paymaster, U. S. N.

PANAMA—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until June 5 for furnishing two-retort crematory, switches, frogs, galvanized steel, steel pipe, pipe fittings, cable clips, bronze wire, etc. Blanks and general information relating to this circular (No. 776) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Industrial Companies

THE ASHMUSEN MANUFACTURING COMPANY, of Kings Park, N. Y., has been incorporated by W. M. Hyde, K. L. Long, of Central Islip, and D. Myers, of Kings Park. The company is capitalized at $100,000 and proposes to manufacture motors, engines, etc.

THE CENTRAL CONDUIT COMPANY, of Tulsa, Okla., has been chartered with a capital stock of $150,000. The incorporators are: Robert H. Childs, Charles A. Guy and Carter Smith, of Tulsa.

THE CLEVELAND ELECTRO METALS COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $20,000 by John W. Brown, Holly G. Wellman and Fred S. Wellman.

THE DULITH-SMITH McMILLAN CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $10,000 to deal in railroad and electric supplies. The incorporators are: E. D. Smith, Eugene Dulith-Smith and Christian N. Berchtold, all of 165 Broadway, New York, N. Y.

THE ELECTRIC MAIL BOX ALARM SYSTEM, of Santa Rosa, Cal., has been granted a charter with a capital stock of $75,000. The incorporators are: M. W. Grindle, E. J. Thompson and J. W. Pemberton.

THE ELECTRICAL SURGICAL APPLIANCE COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $500,000 by H. R. Douglass, F. H. Hadley, E. Loebner, C. Loeffler and W. M. Aydelotte.

THE THERMO ELECTRIC STARTER COMPANY, of Detroit, Mich., has been incorporated with a capital stock of $10,000 by Richard B. Hewett, Edwin S. Bissonette, W. R. Creer and Floyd W. Barstow.

THE TRI-CITY ELECTRIC SERVICE COMPANY, of Hammond, Ind., has been incorporated with a capital stock of $10,000 to do a general electric work. The incorporators are: F. D. Jarvis, L. J. Granger and A. H. Lietz.

THE UNITED STATES SIGN COMPANY, of Gadsden, Ala., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing a patented electric sign. The officers are: W. P. Lay, president; W. G. Bellenger, vice-president; H. P. Barret, secretary; J. W. Penn, treasurer, and W. R. Huston, general manager.

THE VAN DORN ELECTRICAL TOOL COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $300,000. The company will take over the business of the Manufacturing Electrically Driven Tool & Machinery Co., now carried on by the Van Dorn & Dutton Co.

THE WILLIAMS ELECTRIC MEDICAL BATTERY COMPANY, of New York, N. Y., has been incorporated by Louis F. Kuntz, Edgar L. Ostendorf and William W. Northrup. The company is capitalized at $2,000 and proposes to manufacture medical batteries and other electrical batteries.

New Incorporations

SAN FRANCISCO, CAL.—The Erie El. Co. has been incorporated with a capital stock of $1,000,000 by F. V. Pering, J. W. Goodwin, J. L. Holton and F. S. McAllister.

DOVER, DEL.—The American Mining & Pwr. Co. has been incorporated with a capital stock of $6,000,000 by Willard B. Jones and M. M. Mays, both of New York, N. Y.

SUBLETT, IDAHO.—The Sublett Reservoir & Pwr. Co. has been incorporated with a capital stock of $200,000 by Charles H. Powers, L. A. Corey and Daniel Horn. The company proposes to conduct a general irrigation and power business.

HIGHLAND PARK, MICH.—The Highland Park Lt. Co. has been incorporated with a capital stock of $3,000.

IRON RIVER, MICH.—The Iron Range Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000.

ASH GROVE, MO.—The Ash Grove Milling & El. Co. has been incorporated by M. L. Weygandt and others.

OMAHA, NEB.—The Fremont Pwr. Canal Co. has been incorporated with a capital stock of $100,000 by E. S. Eastman, Irving Allison, C. A. Grimmel, James McKenna and Martin W. Dimery.

WATERTOWN, N. Y.—The Northern New York Utilities Co., Inc., has been incorporated with a capital stock of $1,000,000 to erect a hydroelectric plant on the Beaver River and to distribute electricity in Jefferson, Lewis, Oneida, Oswego and St. Lawrence Counties. The incorporators are: George Babcock, H. G. Davis, J. B. Taylor, S. L. George, O. A. Kline, F. A. Rogers and C. C. Burns.

BOLIVAR, OHIO.—The Bolivar Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by H. L. Lash, J. O. Lash, Joseph C. Becker, J. B. Bowen and W. B. Ramsey.

UTICA, OHIO.—The Utica Gas & El. Co. has been incorporated with a capital stock of $30,000 by James M. Kirkpatrick.

HARRISBURG, PA.—Charters have been approved by the State Water Supply Commission for charters for five water and power companies in Lancaster County under the following names: Lancaster County Wtr. & Pwr. Co., to operate in Lancaster County; the Buchannan Wtr. & Pwr. Co., of Lancaster Township; Lafayette Wtr. & Pwr. Co., of Pequea Township; Hamilton Wtr. & Pwr. Co., of Manor Township, and Stevens Wtr. & Pwr. Co., of Conestoga Township.

SOMERSET, PA.—The Somerset El. Co. has been granted a charter with a capital stock of $5,000 to furnish electricity in Somerset. The incorporators are: J. A. Berkey, C. L. Shaver and P. G. Cober.

ALTO, TEX.—The Alto Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by E. C. Bates, W. B. Bates and J. I. Perkins.

EDNA, TEX.—The Edna El. Lt., Ice & Wtr. Co. has been incorporated with a capital stock of $20,000 by L. E. Ward, Rudolph Linnartz and W. W. McCreery.

ELLENSBURG, WASH.—The Ridgeway El. Lt. & Pwr. Association has been incorporated with a capital stock of $1,000 by J. E. Rege and F. G. Prater.

1,061,376. ELECTRODE FOR ELECTRIC-WELDING MACHINES; 1,061,612. REGULATING ELECTRIC FURNACES; P. L. T. Heroult

Trade Publications

LAMP ATTACHMENT.—The Wirt Electric Specialty Company, Philadelphia, Pa., is sending out small blotters advertising its "Dim-a-lite" attachment for an incandescent lamp.

HOLOPHANE PRODUCTS.—A list of some of the many specialties made by the Holophane Works of the General Electric Company is given in a small folder, which includes also illustrations of three types of reflectors.

GENERATORS.—Alternating-current and direct-current steam-turbine-driven generators form the subject of Bulletin No. 153, issued by the Crocker-Wheeler Company, Ampere, N. J. Many illustrations accompany the well-prepared text.

SNAP SWITCHES.—A leaflet being distributed by the Trumbull Electric Manufacturing Company, Plainville, Conn., mentions the important points to note in the construction of the "Circle T" snap switches manufactured by this company.

VALVES.—A catalog showing its complete line of valves has recently been published by the Homestead Valve Manufacturing Company. Within its forty pages are illustrated a wide variety of valves, accompanied by a brief description of each type with price list and principal dimensions.

MOLDED INSULATION.—The General Bakelite Company, 100 William Street, New York, in a booklet recently published, gives a brief talk on Bakelite molded insulation and its general physical properties. Illustrations of molded parts made from Bakelite molding mixtures are shown.

REFILLABLE FUSE.—In a folder being mailed by the Ackley Brake & Supply Company, 50 Church Street, New York, the "trinity of virtues" said to be possessed by the Monarch refillable fuse are set forth. An illustration of the ferrule-contact type and one of the knife-blade-contact type refillable fuse are given.

TIRE PUMP.—The United States Electrical Tool Company, Cincinnati, Ohio, illustrates the U. S. tire pump and drills and grinders in a recently distributed folder. The motor attached to the tire pump is of 0.5-hp rating and is made for either direct current or alternating current, as are also the drills and grinders.

GLOBES.—The Holophane Works of the General Electric Company, Cleveland, Ohio, in a little folder sets forth briefly the adaptability of the Holophane-Realite units. These units are available in large sizes for tungsten filament lamps of from 150 watts to 500 watts and in small sizes for lamps of from 25 watts to 60 watts.

ALTERNATING-CURRENT SWITCHBOARD PANELS.—The General Electric Company has issued Bulletin No. A 4116, describing isolated and small-plant switchboard panels, both generator and feeder, for three-phase circuits. The bulletin is made up principally of dimension and connection diagrams and miscellaneous data referring to the various panels and equipments.

LIGHTING FIXTURES.—Catalog No. 160 of the Wesco Supply Company, St. Louis, Mo., is devoted to its lighting fixtures. It is 10.25 in. by 14.5 in. and contains some excellent illustrations printed on paper free from glare. A number of the designs illustrated show some original, artistic and pleasing effects. Brief descriptions and prices are given. Some fixture accessories are also included.

LIGHTING OF OFFICES, BANKS AND STORES.—Booklet No. 2 has been issued by the National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, Ill., and refers to the lighting of offices, banks and stores by the "Eye-Comfort" system. Illustrations of this system as installed in these classes of buildings are shown, and the advantages of the "Eye-Comfort" system are clearly set forth.

ELECTRICITY IN THE PACKING INDUSTRY.—Bulletin No. A 4119, just issued by the General Electric Company, is devoted to the application of electricity to the operation of packing establishments. It illustrates the various applications of the electric motor. Among the applications mentioned are those of John Morrell & Company, the North Packing & Provision Company, Swift & Company, of Chicago, John P. Squires & Company, and others.

LAUNDRY MACHINERY.—A sixteen-page booklet of the Hurley Machine Company, Clinton & Monroe Streets, Chicago, size 3.5 in. by 6.25 in., illustrates the manner of using the Thor washing machine and wringer and gives convincing practical facts regarding this apparatus. The booklet is free from technicalities and will make interesting reading for the prospective purchaser, as well as good campaign literature for central stations seeking to increase their domestic load.

TAPES AND INSULATING COMPOUNDS.—The Massachusetts Chemical Company, Walpole, Mass., in a thirty-two-page catalog recently issued gives a résumé of facts concerning the goods made by it. Insulating liquids and compounds, insulating tapes and splicing compounds, molded rubber goods and all the many products that come under these classifications are briefly described. The molded goods, including bushings, switch rubbers, rings and gaskets, valves and diaphragms for pumps, regulators and brakes, are illustrated and briefly referred to.

CONDUIT CATALOG.—The Sprague Electric Works of the General Electric Company have recently published a 100-page conduit catalog, No. 439, which covers almost the entire field of conduit products. Several new features in this line are brought before the trade, such as "Greenfielduct," a galvanized, rigid, unlined conduit. A complete list of boxes and covers, including new adjustable and non-adjustable gang floor boxes, and a complete line of standard Greenfield flexible steel conduit, steel-armored conductors, BX cable and armored cord are considered. The publication will be found of interest and convenience to the contractor and jobber.

Business Notes

THE OPALUX COMPANY has moved its New York office from 258 Broadway to the Masonic Building, 71 West Twenty-third Street, New York.

THE CONTINENTAL FIBRE COMPANY, formerly located at 26 Cortlandt Street, has secured quarters at 233 Broadway in the Woolworth Building.

THE PARAGON ELECTRIC COMPANY is the new name of the Paragon Sellers Company. The office will remain at 9 South Clinton Street, Chicago, Ill.

THE HESS STEEL CASTINGS COMPANY, Witherspoon Building, Philadelphia, has developed a process for producing wrought-iron castings, which are said to possess great magnetic permeability for electromagnetic apparatus.

MR. P. A. MORSE, who had been in the employ of the Western Electric Company for a number of years, has opened up an office at 1111 Central National Bank Building, St. Louis, Mo. He will act as a manufacturers' agent with a line of electrical apparatus.

THE SPLITDORF ELECTRICAL COMPANY, New York, manufacturer of electrical ignition devices, has opened a branch office at 8 Harris Street, Atlanta, and will soon open a branch office at 290 Halsey Street, Newark, N. J., and one in Toronto, Ontario, for the Canadian trade.

THE NATIONAL INDIA RUBBER COMPANY, of Bristol, R. I., manufacturer of insulated wires and cables, has moved its Chicago office from 1149 People's Gas Building to its new storeroom quarters at the corner of Clinton and Van Buren Streets, numbered 410 South Clinton Street, and 547-551 West Van Buren Street. Mr. Patrick F. Lyons is manager of the Chicago branch of the company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 13, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,061,256. MANUFACTURE OF SILICON; T. B. Allen and F. J. Tone, Niagara Falls, N. Y. App. filed Nov. 28, 1911. Briquets containing silicious and carbonaceous material are subject to direct heat of an electric arc.

1,061,285. SELECTIVE SYSTEM OF TELEPHONY; R. C. M. Hastings, Columbus, Ohio. App. filed Aug. 29, 1911. Manually operated device at the exchange for selecting a subscriber's set and shunting the uncalled sets.

1,061,286. SELECTING APPARATUS FOR TELEPHONE SYSTEMS; R. C. M. Hastings, Columbus, Ohio. App. filed April 22, 1912. Selecting key with slidable carriage carrying a rotatable selecting member, means for rotating said member and a spring for returning the carriage.

1,061,287. TELEPHONE SYSTEM; R. C. M. Hastings, Columbus, Ohio. App. filed April 22, 1912. Shunt and lock-out device located at substation for cutting out that station when other stations are using the line.

1,061,289. ELECTRIC HEATER; C. C. Heyder, Hansford, W. Va. App. filed Aug. 31, 1912. For heating cautery points; coils mounted in an insulating block which is removable from the casing; spring terminals on the casing are engaged by coil terminals on the block.

1,061,299. ELECTRIC-MOTOR CONTROL; P. N. Jones, Pittsburgh, Pa. App. filed Sept. 23, 1912. For car motors; first connects them in series, then in series-parallel and finally in parallel by establishing parallel circuits which reverse current flow in some of the motors; maintains series connections between motors while effecting the circuit changes.

1,061,311. LINE-WIRE FASTENER; A. M. Morgan, Bridgeport, Conn. App. filed May 31, 1912. U-shaped members encircle the insulator and have eccentric-actuated clamps which engage the wire.

1,061,326. MAGNETICALLY OPERATED TRIPPING DEVICE; M. R. Rodrigues, Brooklyn, N. Y. App. filed Jan. 14, 1911. For controlling clutches, etc.; has a spring-controlled locking rock-shaft and an electromagnet.

1,061,332. BATHROOM HEATER; G. E. Sharpe, Steubenville, Ohio. App. filed Oct. 28, 1912. Casing adapted to be secured in the tiled wall of a bathroom and to contain one or more light bulbs; has a reflector in back of the bulbs and a heater hood overhanging the bulbs.

1,061,375. ELECTRIC WELDING; J. A. Heany, Washington, D. C. App. filed Oct. 7, 1912. "Spot welding"; generator has a flywheel which stores up power and delivers same to the generator during welding periods.

1,061,376. ELECTRODE FOR ELECTRIC-WELDING MACHINES; J. A. Heany, Washington, D. C. App. filed Oct. 7, 1912. Composite rod of steel and copper, copper being used for its conductivity and steel for its high compression factor.

1,061,377. ELECTRIC-WELDING SYSTEM; J. A. Heany, Washington, D. C. App. filed Oct. 7, 1912. Welding transformer has its primary connected to direct-current supply, and auto-manual switches are operated to break primary circuit and induce momentary welding current in the secondary.

1,061,378. ELECTRIC-WELDING MACHINE; J. A. Heany, Washington, D. C. App. filed Nov. 14, 1912. Duration of the welding current is governed by the mechanical means by which the welding electrodes are shifted toward and away from each other.

1,061,433. ELECTRICAL HEATING APPARATUS; H. M. Wicker, New York, N. Y. App. filed May 27, 1908. Linotype pot with thermal control whereby effect of several heating groups is varied by shifting their connection from parallel to series or vice versa.

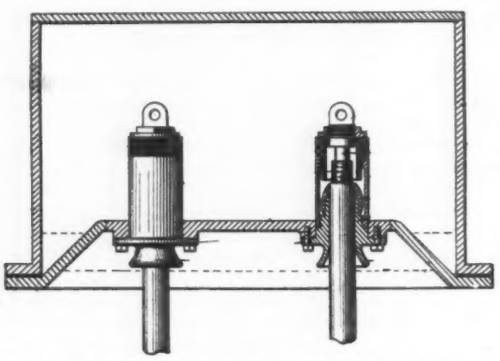
1,061,471. TROLLEY-CONTROLLING DEVICE; A. A. Grossarth and T. E. Barker, Chicago, Ill. App. filed April 5. 1909. Motor operated by compressed air is automatically clutched to the drum for the trolley rope when trolley leaves the wire.

1,061,512. HAMMER; H. B. White, Canton, Ohio. App. filed March 21, 1908. Magnet coil, switching mechanism and a common manually operated means for releasing the reciprocating part and operating the switch mechanism to control the coil.

1,061,514. ELEVATOR ALARM; J. C. A. Anderson, Chicago, Ill. App. filed Nov. 7, 1911. Alarm is operable only when car is standing still, and hence only the dead weight is indicated and not the increased weight at starting or accelerating speed.

1,061,515. TELEPHONY; C. A. Bals, Chicago, Ill. App. filed April 24, 1911. Trunk line between exchanges, cord circuit and means to disassociate the electromagnetically controlled cord circuit apparatus from the cord circuit when the cord circuit is to be used in connection with the trunk line.

1,061,516. TELEPHONE EXCHANGE SYSTEM; C. A. Bals, Chicago, Ill. App. filed March 3, 1909. When cord circuits unite two lines in conversation the operator's telephone is rendered temporarily inoperative to prevent eavesdropping.



No. 1,061,527.—Junction Box for Electrical Cables.

1,061,519. CONTROLLING APPARATUS; W. G. Blauvelt and E. C. Molina, New York, N. Y., and East Orange, N. J. App. filed Nov. 13, 1911. For automatic telephone systems; counting apparatus comprising series of contact devices corresponding to a series of impulses and arranged in groups, with an energizing circuit and means for alternately connecting the groups to the circuit.

1,061,527. JUNCTION BOX FOR ELECTRICAL CABLES; C. W. Davis, Edgeworth, Pa. App filed Feb. 24, 1909. Box has a dished bottom through the raised portion of which the conductors are passed; a thimble engaging the cable sheath and the wall of the box makes a water-tight joint.

1,061,529. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE; W. Doinikoff, Baden, Switzerland. App. filed April 28, 1909. Auxiliary armature core with winding inserted between the main winding and the commutator, with inductive winding on the field poles separate from main field winding, and commutating poles with winding fed from second winding on the main field poles.

1,061,541. PRIMARY BATTERY; E. E. Hudson and D. Elmes, Newark and Orange, N. J. App. filed Sept. 19, 1910. Positive plate having a small depression on the side furthest from the negative element, which as the plate is consumed produces a hole in the plate and thus gives warning of the need for renewal.

1,061,550. DEVICE FOR DRIVING ELECTRIC CLOCKS AND SIMILAR APPARATUS; G. O. Larson, Stockholm, Sweden. App. filed Oct. 1, 1908. A condenser takes up and delivers the driving currents of the clock, circuit of the condenser being periodically made and broken by the clock.

1,061,572. ELECTRIC BATTERY; C. F. Schuh, Newark, N. J. App. filed Aug. 9, 1912. Dry battery in which loops of conducting wire are connected to the respective electrodes and serve as terminals, the loops being covered with insulation displaceable by pressure.

1,061,578. PUSH-BUTTON SWITCH; H. Wischausen and A. Hepke, Berlin, Germany. App. filed March 25, 1912. A single spiral spring subjected to both compressive and torsional strain serves both to return the push-button and to rotate the switch member.

1,061,583. APPARATUS FOR REPAIRING ELECTRIC METALLIC-FILAMENT LAMPS; O. Arendt, Berlin, and C. Schlesinger, Strassburg, Germany. App. filed Oct. 4, 1911. Holes fused in end and sides of bulb through which old filaments are removed and new ones introduced.

1,061,589. BUSY SIGNAL ATTACHMENT FOR TELEPHONES; A. M. Beeler, Seattle, Wash. App. filed Jan. 9, 1912. Receiver hook operates switch to close circuit through lamps carried by the other instruments on the circuit, thus giving notice that the circuit is in use.

1,061,598. ESCAPING-GAS ALARM; O. Casilli, Newark, N. J. App. filed March 25, 1911. A bag is inflated by the escaping gas and serves to close an alarm circuit.

1,061,612. REGULATING ELECTRIC FURNACES; P. L. T. Heroult, La Praz, Savoy, France. App. filed Jan. 21, 1909. A regulating circuit for bringing furnace to the desired operation, means for changing course of current in said circuit and holding it in its course until the regulation is effected, and an interrupter for causing the current to pass intermittently.

1,061,620. INSULATOR; H. R. Markel, Columbus, Ohio. App. filed July 31, 1911. Base and a crown with wire grooves therebetween, the crown having tapered lugs fitting in corresponding recesses in the base.

1,061,624. ELECTROMOTOR; C. R. Moore, Lafayette, Ind. App. filed March 14, 1912. Combination with a swingingly mounted armature of a permanent magnet and an electromagnet.

1,061,647. FLUSH SWITCH; J. J. Wesley, Douglaston, New York, N. Y. App. filed April 6, 1911. Has two end clips and an intermediate clip, and switch plate has end blades and an intermediate blade to co-operate therewith.

1,061,650. TELEPHONE SYSTEM; F. G. Agrell, Stockholm, Sweden. App. filed Oct. 10, 1906. Semi-automatic; calling subscriber is automatically connected to central exchange and when so connected his talking circuit is entirely independent of that of any other line.

1,061,651. TELEPHONE SYSTEM; F. G. Agrell, Stockholm, Sweden. App. filed Oct. 10, 1906. Semi-automatic; calling subscriber is automatically connected to a switching circuit controlled by an operator or other means which is not busy at the time.

1,061,666. MAGNETIC SEPARATOR; H. W. Freese, Chicago, Ill. App. filed Sept. 11, 1909. Rotating electromagnets extend into the material and deflect the apron, carrying the material into the curved recess formed in a member of magnetizable material located under the apron.

1,061,671. LIGHTNING ARRESTER; J. D. Hillard, Jr., and C. E. Parsons, Glens Falls, N. Y. App. filed Jan. 29, 1906. For multiphase circuits; a bridge between each line and a common point, an adjustable high-potential discharge means and an adjustable resistance in each bridge, and a separate high-potential discharge means between the common point and ground.

1,061,733. HARMONIC ELECTRIC BELL OR RINGER; C. J. Erickson, Chicago, Ill. App. filed Dec. 18, 1905. Polarized type; striker is mounted on a spring yoke secured between the ends of the electromagnets, and striker is slidably adjustable for different frequencies or periods of vibration.

1,061,758. ELECTRODE; C. R. Krueger, Schenectady, N. Y. App. filed Oct. 16, 1911. Contains titanium carbide and a small percentage of metallic copper.

1,061,763. ELECTRIC FIRE ALARM; L. J. Loeffler, Stapleton, N. Y. App. filed Jan. 13, 1912. Spring motor and circuit-breaker.

1,061,766. DIAPHRAGM OF TELEPHONIC RECEIVERS AND LIKE INSTRUMENTS; A. Marr, Manchester, England. App. filed Sept. 12, 1912. Diaphragm is gripped only around the extreme peripheral corners of both faces so as to have great freedom of movement.

1,061,786. DEVICE FOR SYNTHESIZING GAS; W. Seibert, Charlottenburg, Germany. App. filed Feb. 5, 1908. Gases are passed while rotating into an annular space between two electrodes whereby the arc takes a disk-like form.

1,061,809. BINDING POST; F. E. Bocroselski and C. K. Lassiter, Richmond, Va. App. filed Nov. 2, 1911. Movable sleeve is actuated by spring to clamp the wire automatically.

1,061,813. TELEPHONY; S. G. Brown, London, England. App. filed Feb. 4, 1910. Variable-resistance contact device comprising two hard surfaces with a granule of osmium-iridium alloy interposed between them.

1,061,823. TIE WIRE FOR HIGH-VOLTAGE CIRCUITS; J. Cronin, Wapakoneta, Ohio. App. filed May 13, 1912. Two wires are passed around on opposite sides of the insulator and are attached together, the free portions of the wires being wrapped around the live wire, and the wires are provided with looped ends by which they are manipulated.

1,061,824. LIGHTNING ROD; J. Z. Curnutt and E. E. Lloyd, Maryville, Mo. App. filed April 9, 1912. Central tension wires, spacing wires wrapped spirally about the same, and outer spirally wound conductor wires; also has a sheet-copper terminal clamped upon the cable.

1,061,849. TRANSMITTER; F. Kayser, Philadelphia, Pa. App. filed Jan. 7, 1913. A pivoted carbon lever extends up through the post of the instrument, being connected with the diaphragm at its upper end and bearing upon carbon granules at its lower end.

1,061,852. EXCHANGE SYSTEM FOR TELEPHONE LINES AND THE LIKE; A. Lawrence, Elizabethtown, Ill. App. filed April 13, 1912. A jack for each transmission circuit, circuits connecting all jacks in multiple, plugs co-operative with the jacks to interconnect selected transmission circuits, and a signal for each transmission circuit.

1,061,863. RAILWAY SIGNAL SYSTEM; W. D. Nickum, Los Angeles, Cal. App. filed April 2, 1909. Cab system with insulated contact rail along trackway.

1,061,892. METHOD AND APPARATUS FOR THE PRODUCTION OF LONG ELECTRIC ARCS FOR THE TREATMENT OF GASES; F. H. A. Wielgolaski, Christiania, Norway. App. filed Sept. 19, 1912. Forms an arc between the inner ends of a pair of electrodes disposed in a pair of branching channels and blows the roots of said arcs back from the inner ends of the channels by passing currents of gases through the channels.

1,061,894. PROTECTIVE APPARATUS FOR ELECTRIC CIRCUITS; R. L. Baker, Joplin, Mo. App. filed Jan 13, 1912. Fuse plug with reciprocal plunger normally held retracted against tension of a spring by the fuse.

1,061,895. CABLE ROLLER; F. M. Bierce, Cincinnati, Ohio. App. filed Oct. 21, 1911. Open frame carrying a roller which supports the cable is clamped adjustably upon the messenger wire.

1,061,898. TELEPHONE LOCK-OUT; W. L. Campbell, Chicago, Ill. App. filed Feb. 26, 1907. Automatic system; calling dials automatically connect the calling subscriber with the called subscriber.

1,061,919. MAGNETIC SWITCH; C. G. Miller, New York, N. Y. App. filed Sept. 19, 1912. Imperforate support, with a pivoted circuit closing arm carrying a permanent magnet located on one side of the support and an armature movably mounted on the other side of the support.

1,061,960. ELECTRIC SIGNALING; F. W. Lyle, Lynn, Mass. App. filed Aug. 22, 1911. Selective devices each comprising a plurality of boron resistances of unequal resistance break-down characteristics.